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The Soils of Fulton County, Pennsylvania

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AND USE

The Pennsylvania State College
SCHOOL OF AGRICULTURE
Agricultural Experiment Station, State College, Pa.

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CONTENTS

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Their Origin, Classification, and Use

Howard W. Higbee†

FULTON COUNTY IS LOCATED in the Appalachian Ridge and Valley Section of south-central Pennsylvania. The county is roughly rectangular in shape and includes a land area of approximately 435 square miles, or 278,400 acres.

McConnellsburg, the county seat and largest town in the county, had a population of 1,055 in 1940. It is located in the east-central part of the county in a fertile limestone valley that is surrounded by steep, rugged, mountains, fig. 1.

Transportation

Fulton county has no railroads. The nearest railroad stations are at Mercersburg and Fort Louden in Franklin county, and at Hancock, Maryland, 2 miles beyond the southern border of the county.

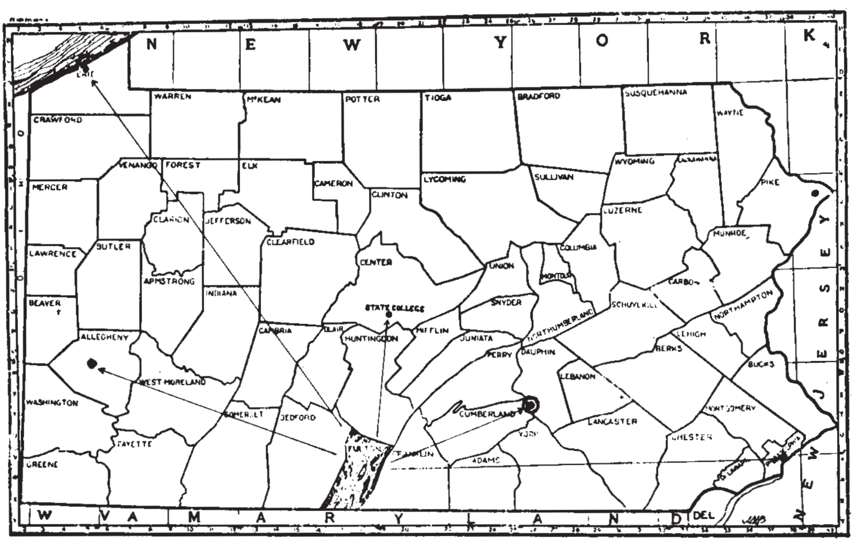

Fig. 1.—Fulton county is located in the folded mountain region in south-central Pennsylvania.

* Authorized for publication May 6, 1947.
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In general, transportation to and from Fulton county is provided by several all-weather paved roads and highways. The Lincoln highway (U. S. 30) and the recently constructed 4-lane super-highway officially named The Pennsylvania Turnpike gives the central and northern portions of the county adequate transportation outlets west to Pittsburgh and east to Philadelphia, New York or Baltimore. Several paved roads radiate outward and into the southern part of the county from Hancock.

Physiography

The Appalachian Ridge and Valley Section of the greater Appalachian Mountain System rises in northeastern Pennsylvania, fig. 2, from where it broadens and becomes more extensive as it extends westward and southward across south-central Pennsylvania and western Maryland. This folded mountain region extends southward through Virginia, eastern Tennessee, and into northern Georgia where it terminates.

In some pre-historic era, the entire Appalachian Ridge and Valley Section was subjected to terrific earth pressures and disturbances that caused the earth's crust to buckle, fold, warp, or break until practically all of the geological formations were twisted, faulted, and upturned at steep angles. Millions of years of geologic time, weathering, and erosion leveled the huge anticlinal or synclinal folds until the whole region was reduced to a rather level smooth plain of low relief. This leveling-off exposed the upturned edges of many different kinds of rock materials.

After the whole region was reduced to a temporary base plane, there came another great earth crust movement that uplifted the entire Appalachian Mountain Region from 1,500 to 2,000 feet or possibly more in places. This great uplift introduced a new and very vigorous land erosion cycle. All the streams began to flow faster and because of this, their channels have been cut deeper and deeper into the rocks of the region.

As time passed and rain continued to fall over the area, the processes of rock decay and land erosion continued until great valleys were formed where the shales and limestones weathered away most rapidly. The present day landscapes of this great region spread before one the product of millions of years of geological history, and it is from these landscapes that one may learn of the great geological events that have entered into the sculpturing of the Appalachian Mountains and Valleys within which Fulton county is located. Every mountain, every valley, every hill, and every stream is a page of geologic history.

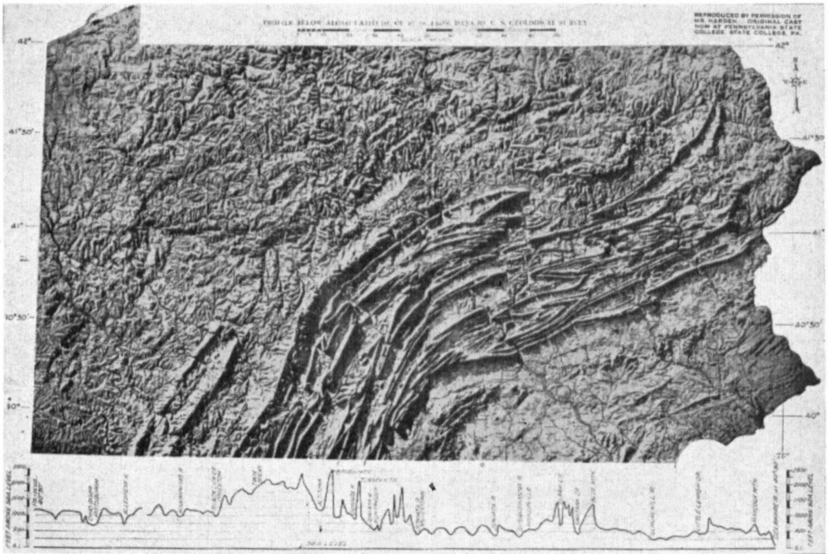

Fig. 2.—Relief map of Pennsylvania.

Fulton county occupies but a small portion of the Appalachian Mountain System, but it contains practically all of the topographic and physiographic features that are common to the Appalachian Ridge and Valley Section of south central Pennsylvania.

Geology and Topography

The surface geology of Fulton county includes three major groups of rock materials. They are: (1) hard sandstones which occupy the high mountain areas, (2) various kinds and colors of shales that occupy the "shale hills", and (3) the limestones that occupy the "limestone valley" areas.

The hard sandstones are very resistant to all forms of weathering, and this in part explains why these rocks now occupy the higher elevations and mountain tops of this region. At the present time exposures of these hard sandstones occupy elevations ranging from 1,800 to 2,200 feet above sea level. These sandstones occupy the very highest points or crests of the long, narrow, steep-sided, sharp-topped mountain ranges that extend for many miles in a north-east south-west direction. The only break in these long narrow mountain ranges is where fault lines or weaknesses in the sandstone formations permitted streams, as they flow from one valley to another, to cut deep notches, or gaps through the mountains.

In brief the mountains of this region, and the protective barriers to the valleys they enclose, owe their origin to the hard sandstones that uphold their elevations.

Weathering and erosion have lowered the inter-mountain valleys until they are from 800 to 1,000 feet below the mountain tops. The lower valley floors are upheld by the upturned edges of massive limestone formations which impart to such areas a rather smooth rolling topography interrupted here and there by sink holes or depressions and protruding limestones.

There are only three important exposures of limestone in Fulton county. The largest and most extensive underlies the long narrow valley, "The Cove," in which McConnellsburg is located. The next in importance is in Pigeon Valley in the vicinity of Warfordsburg in the southern part, and the third area, a small exposure in the vicinity of Fort Littleton, is in the northern part of the county.

Between the low-lying limestone valleys and the high mountain areas are massive beds of shale exposed at steep angles. Shale materials decay much faster than the hard sandstones of the high mountain areas but slower than the limestones of the low valley floors. Therefore, the surface exposures of the shale materials now occupy elevations ranging from 800 to 1,000 feet below the high mountains and from 300 to 500 feet above the lower limestone valleys. At present the elevations for the shale areas range from 800 to 1,200 feet above sea level. (See elevations on soil map).

The late geologic erosion cycle, because of the last or second uplifting of the entire region, has been very aggressive in the redissection of all the lower valley areas. A study of the accompanying soil map and its topographic lines will show the degree to which this late redissection has progressed.

Geologic erosion and dissection gave the whole region three distinct and separate types of land relief. They are: (1) rugged, high mountains, (2) steep, rolling shale hills and valleys, and (3) fairly smooth but rolling uplands of the limestone valleys. The present topography is the product of many geologic events combined with the inter-reactions of rock weathering and land erosion which has been going on over the entire region for millions of years.

Even though the rates of rock decay have been comparatively rapid throughout the region, the rates of soil material accumulation have been comparatively slow because geologic erosion has carried away the soil material about as fast as it has formed.

Accumulation of Soil Materials

The accumulation of soil material resulting from the physical and chemical decay of rocks or shales involves millions of years of geologic time. As the soil material accumulates, it absorbs and stores water which in turn makes plant growth possible. Growing plants cover and protect the soil from beating rains and water erosion, and the decay of their leaves and stems enriches the surface soil with soil humus. As time passes the enriched surface soil becomes deeper and more productive of plant growth.

By the time the white man entered Fulton county, there was a rather deep accumulation of soil over the entire area. Magnificent forests abounded, wild animals were in abundance and, fish were plentiful in the clear sparkling waters that flowed in the streams.

Approximately 200 years have passed since the first settlements of white men were made in Fulton county. During this period important changes have taken place. The American Indian is gone. He was kind to the land and the forests. The virgin forests are gone, and in their place we now have cut-over lands and second or third growth hardwoods. The American chestnut, like the Indian, is gone. Now, wherever the land is cleared and cultivated, the soil is eroding many times faster than new soil can be produced from the underlying rocks.

Conservation and erosion control is now of vital importance if future generations are to have food producing soils in this area.

Land Drainage

Surface drainage and water run off from this area is rapid, excessive, and frequently destructive. Geological erosion has been rapid and now man-made erosion is very aggressive. About three fourths of the surface run-off flows south to the Potomac river in Maryland. The remainder flows north to the tributaries of the Juniata river which empties into the Susquehanna river, approximately 22 miles above Harrisburg. For more detailed information relative to drainage, the reader is referred to the enclosed soil map.

In general, the streams flow at high levels in late winter and early spring when melting snow and rainfall combine to give excessive surface water run-off. The low bottoms or stream flood plains are flooded most frequently in late winter and early spring. The most destructive flood on record in south-central

Pennsylvania was in March, 1936, when heavy rains fell on frozen soils that were deeply covered with melting snow.

In late summer and early fall, the level of the streams throughout the region usually is very low, and many of the smaller streams cease flowing. Some become completely dry. All streams shown as intermittent on the soil map usually stop flowing in late summer.

Ground water levels for most of the area are very deep. Water is found at shallowest depths in the limestone valleys where water may come to the surface to form springs. Throughout the shale hill sections, ground water is very deep and many farmers use water that has been stored in cisterns.

Streams or springs that rise near or at the base of the high mountain areas usually flow throughout the year, and they may be depended upon as permanent sources of water.

Climate *

The climate of Fulton county, typical of the Appalachian ridges and valleys, is truly continental or of the inland type with prevailing continental winds moving eastward over the area. Winds from the west are usually drying and accompanied by clearing weather, but winds from the east are usually very humid and may bring several days of wet, cloudy, or even foggy and misty weather particularly in early spring. Spring and summer are the calm seasons of the year when gentle breezes blow north and eastward over the area. The strong, hard, cold, and blustery winds are from the west; they are strongest in November and December.

The summers are generally warm with but few days having temperatures above 90° Fahrenheit. The total amount of sunshine for the area during the growing season is satisfactory for most crops. If August is cool and cloudy, some crops, like corn and soybeans, may be delayed in maturity to the point of being damaged by frosts in September.

The winters are often long, dark, and gloomy with much cloudy weather from early November until the middle of March. Winter temperatures in general are not extremely cold, but occasionally in January or February temperatures may go as low as —10° or —15° F. The ground is often frozen by mid-December and usually stays frozen until late March. Snow often covers the ground from early December until late March. The approximate annual snow fall for the area is 34 inches.

* Many of the data on climate were obtained from U. S. Weather Bureau.

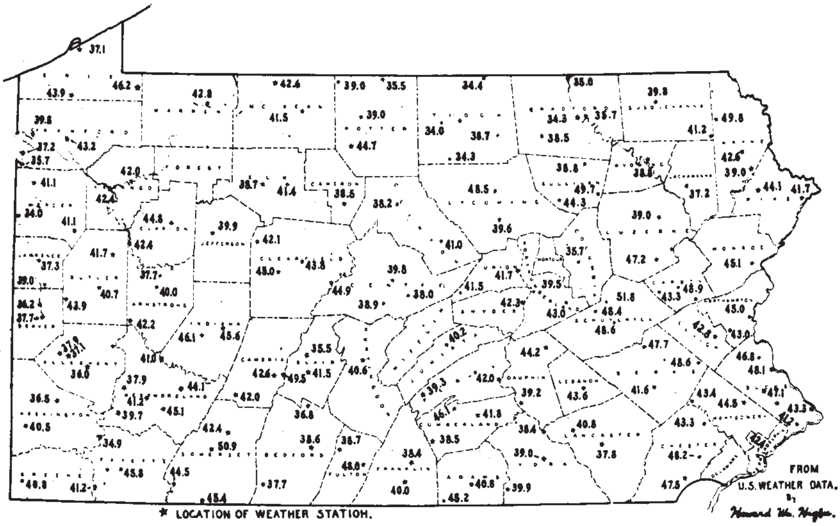

Fig. 3.—Average annual precipitation in Pennsylvania in inches.

The average annual precipitation in the form of rain and snow for the area is approximately 48 inches per year. United States Weather Bureau data show the general distribution of the yearly precipitation to be:

Late Winter and Early Spring		Summer Growing Season		Fall and Early Winter	
	inches		inches		inches
January	3.40	May	6.48	September	3.03
February	3.11	June	4.08	October	3.41
March	4.44	July	4.66	November	3.60
April	3.43	August	5.28	December	3.12
Total	**14.38**		**20.50**		**13.16**

The maximum amount of rainfall that may be expected within a 24-hour period is 4.75 inches. The highest summer temperature recorded for the area was 102° F., and the lowest winter temperature about —25° F.

The average date for the last killing frost in spring is May 10, the latest recorded date being June 10. The average date for killing frost in the fall is October 5, but the earliest date recorded is September 21. The average length of the frost-free season is about 150 days. The length of the good growing period is about 130 days except for cool wet summers when it may be shortened to 120 days.

Weather records alone are not sufficient for predicting success or failure of specific crops in a given region, for local conditions such as "frost pockets", total quantity and distribution of sunshine, rainfall occurrence or distribution, and variations in winter temperatures all affect plant materials and crop production. The ability of soils to attain warmth in early spring often determines planting dates, and the capacity of soils to store water may effect crop yields.

In Fulton county where the land surface is hilly or steep, the angle of land surface exposure to the sun affects planting dates, crop maturity dates, and winter survival of certain crops and fruits. In mountain valley areas, low places fill with cold air on still cool nights. These areas, "frost pockets", are often subject to heavy frosts in late spring or early fall when higher locations escape damage. Early field crops, gardens, vegetables, and orchards are very susceptible to severe injury by late spring or early fall freezing; therefore, they should not be located in low frosty areas. Orchards in Fulton county should be located on high ground, preferably on northeast slopes away from prevailing west winds that tend to dry the soil in summer and freeze it deeply in winter.

Early History and Development *

The area that is now Fulton county attracted white settlers as early as 1729, but the initial granting of land occurred in 1741 and 1742 when a settlement was attempted near or at a site now known as Burnt Cabins. This early settlement was considered illegal and was ordered abandoned and destroyed by Richard Peters, Secretary of the Province of Pennsylvania, in May, 1750, because it violated earlier land treaties that had been made with the Indians. Following the destruction of that early settlement, there later arose on the original site a village named Burnt Cabins, which remains to this day in honor of an event that goes back to the very beginning of land use by white men in Fulton county. Fort Littleton received its name from a military fortification that was constructed near the present site of this village during 1755-56. This early fort was essential for the protection of white settlers from Indian raids.

The first white settlement in the vicinity of McConnellsburg was made by David Scott, November 6, 1749. The earliest

* Most of the material presented under this title was taken from the "History of Fulton County, Pennsylvania" by Elsie S. Greathead, printed by the Fulton County News, McConnellsburg, Pa., 1936; and "Early Fulton County History" by Walter R. Sloan, published in "One Hundred and Fiftieth Anniversary of the Founding of McConnellsburg Historical Handbook and Program", 1936.

pioneers were Scotch-Irish who settled on the more fertile limestone valley areas. Early English and French settlements were on the less productive shale lands. By 1775 the Indians were forced out of the area and land settlement increased rapidly from 1775 to 1790. By 1800 practically all of the area was under control of white people.

The first school was started at Big Spring in 1777. Another was started in 1780 about one-half mile south of McConnellsburg.

The early development of the area was based on the establishment of homes and the production of those crops that could be used as food for both man and his animals, a truly subsistance type of agriculture. Later lumbering became important. As more land was cleared, it was devoted to the production of crops, mainly cereal grains and hay. As soon as roads were opened to eastern markets, the farmers began to export wheat and whiskey. Later the fattening of hogs and cattle for eastern markets became important.

Soon after 1800 there was a wave of water power development and a number of grist mills and saw mills were built. The expansion of milling encouraged more land clearing and the growing of more grain. Flour was exported and bran and middlings were used locally as feed for livestock.

Agriculturally the area developed rapidly until the Civil War. During the Civil War it was constantly in danger of invasion. Confederate raiding parties visited McConnellsburg twice. At the time of the last raid, destruction of the entire town seemed certain, but the inward kindness of a Confederate officer caused him to kick apart a fire that was being started; thus McConnellsburg was saved.

After the Civil War the opening of the West brought about a general lowering of values of agricultural products, and to this day Fulton county agriculture has not fully recovered from the effects of wars, depressions, and the ever present competition with western agriculture.

Organization of the County

Fulton county originally was part of Cumberland county when it extended west to the Allegheny escarpment. When Bedford county was set apart in 1771, Fulton county became part of Bedford county. The eastern border of Fulton county was established when Franklin county was set apart from Cumberland county in 1789 at which time the top of Tuscorora Mountain became the boundary line between Bedford and Franklin counties.

Fulton county came into existence by an Act of the legislature, approved April 19, 1850, whereby provision was made for the establishment of a new county. The name was to have been Liberty county but Senator Packer of Lycoming county who introduced the act was given the privilege of naming the county, and he selected the name Fulton.

The top of Rays hill was to be the boundary line between Fulton and Bedford counties. The north county line was to be the southern boundary line of Huntingdon county and the southern boundary was to be the Maryland-Pennsylvania state line. To this day there have been no important changes in boundary lines of Fulton county, and the total area enclosed, according to the latest available data, is approximately 278,400 acres or roughly 435 square miles.

Natural Vegetation

The natural forest cover of Fulton county was typical of that of the Northeastern Hardwood Forest Region of the United States in that it was mainly a combination of oak, chestnut, and pine. In the high mountain areas, the forest cover was mainly of the oak-chestnut-pitch pine complex with oak definitely dominating after the chestnut had been eliminated by "blight", a disease which killed most of the chestnut trees in this region between 1912 and 1920. The more important kinds of oak found on the mountain tops were chestnut and scarlet and to a lesser degree red oak. On the broad mountain tops that have been burned over frequently, the forest cover has been reduced to a low growing scrub-oak type of forest. In most of the high mountain areas the undergrowth is mainly mountain laurel, huckleberries, and blueberries.

In the valleys the forest cover now is a mixed stand of oak and pine. Red oak and scarlet oak are most abundant with white oak becoming important on the better soils and dominant over the limestone valley areas. White pine is the important pine on the lower mountain slopes and out over the deeper, shallower, and more droughty shale hill areas. Walnut, hickory, and beech trees are largely confined to the limestone valleys and the alluvial flood plains where the soils are deep, moist, and fertile. A few sycamore trees are found along the stream banks where the soils are both deep and moist.

Practically all of the mountain areas are occupied by forest. Much of the steeper shale hill land remains under natural forest cover. The most extensive clearing of land has been in the limestone valley areas. In 1940, approximately 65 per cent of the

county was occupied by native forests. In addition there was a considerable area of badly eroded or abandoned land that had been turned back to nature. Scrub pine is about the only tree that seems to be able to establish itself on impoverished soils that are too shallow and droughty to support a new generation of hardwoods. Most of the forest land of Fulton county had been repeatedly cut over until at this late date the supply of timber that was suitable for quality lumber was not abundant.

A SOIL SURVEY

When the early pioneers came to what is now Fulton county, the natural vegetation, together with their previous knowledge of soils and crops, served to guide them to those areas where the most productive soils occurred. The earliest settlers selected the most fertile lands of the limestone valleys because agricultural prosperity at that early date was largely determined by the natural fertility that existed in the soil.

From the beginning the people of this area used geological terms when referring to their soils. Those in most common use are: "limestone soil", "red shale soil", "yellow shale soil", "gravelly soil", "sandstone soil", and "bottom land". These terms have great merit and they have been very useful to the people of this area.

The first study and classification of the soils of Fulton county was very general; it was included as part of "The Reconnaissance Soil Survey of South-Central Pennsylvania" as made in 1910. In 1941 a second study and survey of the soils of Fulton county was made and the findings are presented in this publication. The combined findings of such a study and survey are generally contained in a soil survey report. People often ask: "What is a soil survey? How is it made? What good is it?" The answers are:

A soil survey is a systematic study and survey of the soil resources of a given area made for the purpose of gathering information as to the origin, development, classification, and use of the soils found therein. The geographic location and extent of each different kind of soil is accurately located and outlined by soil boundary lines on a very accurate and detailed base map of the area. The map when completed becomes a "Soil Map."

During the process and progress of the field work the soil surveyor assembles a large amount of information in the form of field notes which include information as to origin, classifica-

tion, and use of each kind of soil. From his field notes and other data, he assembles a Soil Survey Report that accompanies the Soil Map.

How a soil survey is made.—The first step in the making of a soil survey of a given area is the selection of the most accurate base map that can be obtained. The base maps used for Fulton county were U. S. Geological Survey topographic maps. In cases where there are no suitable base maps, the soil surveyor frequently has to make his own base map and soil map as a single and combined operation.

The second step in a soil survey is a general study of the area for the purpose of finding out how many and what kind of soils it contains. From this study the surveyor prepares a legend that is used as a key for mapping of the different kinds and types of soils found in the area.

The value of a soil survey.—A soil survey is primarily an inventory of the soil resources of a given area. It provides information relative to the origin, classification, and use capabilities of soils.

Within the last few years, research has shown numerous, very important nutritional relationships between soils, crops, and the animals of certain areas. That is, if the soil is deficient in some specific mineral nutrient, the same deficiency often shows up in the well-being of the plants and animals that are produced from foods grown on such soils.

The crop producing capacity of a given area may be controlled or limited by the kind of soil present in the area or its capacity to respond to lime and fertilizer treatments. In this capacity accurate soil maps are of great importance. The modern soil survey map and report contains a large amount of fundamental information that may be valuable in planning the management of soils for crop production.

Origin of Soil Material

Soil, as we know it, is the product of many physical, chemical, and biological processes all of which operate together in changing hard rocks into the soft mellow soil that man cherishes as a medium from which he is able to grow crops that provide food for himself and his animals.

To fully appreciate the enormous amount of time required (millions of years) for the creation and development of soils, one should become better acquainted with the processes involved in the formation of soils. Some of these processes are briefly outlined.

Physical processes of soil formation.—These processes result from the forces of wetting and drying, freezing and thawing, frost and gravity, and flowing water.

WETTING AND DRYING—In Fulton county, it is only the shale rocks that are greatly affected by wetting and drying. The clay minerals in the shales when wetted have a tendency to swell; then when they dry, they shrink. The repeated effects of shrinking and swelling eventually causes shales to crumble. This effect often occurs where shales are exposed by deep road cuts through shale hills where, because of wetting and drying and freezing and thawing, the shale crumbles and rolls down the steep slopes, often filling the drainage ditches along the sides of the road. Limestones and hard sandstones are affected very little by wetting and drying because they contain very small amounts of clay material. This in part explains why limestones and sandstones can be used in the construction of buildings.

FREEZING AND THAWING—If a rock absorbs water, as sandstones and shales do, and the water is frozen, there is a volume expansion of about 8.3 per cent. If there is no room for the water to expand, a pressure of some 2,000 pounds per square inch is developed. Rock materials can not hold together under such pressures; so most rocks exposed to freezing and thawing in a humid region crumble, or disintegrate rapidly and by this process eventually become soil forming material.

The depth to which frost is able to penetrate and break up rocks is determined by climate. In Fulton county, frost penetrated deeper during the ice ages than it does at the present time. A careful study of the soils shows that for most of the shale and sandstone areas the depth of soil material, as produced by the physical agencies of rock weathering, is about 2 feet. When the ice age retreated from northern Pennsylvania, the depth of frost penetration became less and less. Now the depth of frost penetration during the winter months varies from 12 to 15 inches. At present the climate is not cold enough in winter to bring about the development of deep soils; therefore, it is important that the farmers of this area use every method or scheme that is available for the conservation of their soil resources.

FROST AND GRAVITY—Where slopes are steep, frost and gravity cause loose soil to move downward, and the soil material may creep or slide down the slope even more rapidly when saturated with water. Such a condition gives rise to mud flows. Soil materials which have accumulated to great depths as a result of these forces are called "colluvial soils." In Fulton county extensive areas of colluvial soils are developed at the base or lower

slopes of practically all of the higher mountains. See soil map for distribution of colluvial soils in Fulton county.

FLOWING WATER—In hilly or mountainous areas water flows rapidly down the steeper slopes and picks up large quantities of soil material. Then when the speed of the water is reduced, as it flows through the valleys, the soil material settles to form deposits of "alluvial soils." These are the soils that make up the flood plains and stream terraces along streams. Originally most of the alluvial soil came from the surface of residual upland soils, and this in part accounts for the presence of the large quantities of humus contained in the alluvial soils.

Chemical processes of soil formation.—Under these processes are listed the influences of water, acids, and gases on the chemical decay of rock materials. The annual rainfall in Fulton county is approximately 48 inches. If one considers the number of years that rain has been falling over the area, he realizes that the soils of this region have been leached by huge quantities of water. As water goes down through the soil, the more soluble elements are leached from the soil. Limestones contain calcite ($Ca\ CO_3$) and other soluble minerals which are continually being dissolved by water. As the dissolving action continues over a long period of time, the insoluble mineral residues released from the limestones accumulate to form soil material. Water in the wells of limestone regions is described as being "hard" for it has lime in it that was dissolved away from the limestones.

When carbon dioxide gas (CO_2) of the atmosphere combines with water, (H_2O), carbonic acid (H_2CO_3) is formed. This acid together with other organic acids from decaying organic matter dissolves limestones much faster than water alone. The depth to which the dissolving action of water and acids may dissolve limestone rocks is unlimited, and this is one reason why soil material accumulates to greater depths over limestone areas than over acid shale or sandstone areas. The dissolving action of acidified water is also responsible for the development of caves and caverns which are of frequent occurrence in limestone valleys.

In Fulton county the processes of chemical decomposition of rock materials are most active over the limestone or calcareous shale areas, and the physical processes of rock disintegration are confined mainly to the shale and sandstone areas. In general the soils of the limestone valleys are deep and those of the shale hill areas are shallow.

Soil Development

The soil, as we know it, is a product of many soil developing processes other than those that change geological materials into soil materials. As soil material accumulates it has imposed upon it the forces and effects of its surrounding environment. They are: climate (rainfall and temperatures), vegetation, organic matter decay, soil drainage, topography, geological erosion, and others of lesser importance.

The climate of this region brings to the area an abundance of rainfall (48 inches per year). When such a great volume of rainwater moves downward through the soil, it leaches important plant nutrients and minerals away. Those that are most easily leached are nitrogen in the form of nitrates (NO_3) and lime in the form of calcium. Seasonal temperatures for this region limit plant growth to a period of not more than six months. During the cold period (November to April) of the year, the natural vegetation of the area, which is hardwood forest, is held in dormancy because of freezing temperatures.

The decay of organic matter is carried on by tremendous populations of bacteria, fungi, insects, and earthworms, which like plants become dormant when freezing temperatures penetrate the soil. The continued effect of climate (warm summers and cold winters) brings about cycles of decay and dormancy that are responsible for the development of organic acids as intermediate products of decay in the organic matter. Rain water or water from melting snows carries these acids down into the surface soil where they exert a powerful leaching effect on soil minerals. This organic acid leaching process has been combined in the term "podsolization." The process operates only in humid cool climates where forest litter decays slowly. Podsolization is a very powerful leaching process and in extreme cases it has the ability to dissolve iron from the surface soil. This process of soil leaching developed strong acidity in the surface of practically all of the upland soils of this area long before they were cleared for agricultural use.

The degree of acidity or alkalinity that is contained in soils may be expressed as: Very acid (pH 4.0 to 5.0), strongly acid (pH 5.0 to 5.7), medium acid (pH 5.8 to 6.5), slightly acid (pH 6.6 to 6.8), neutral (pH 7.00), slightly alkaline (pH 7.2 to 7.5), and medium alkaline (pH 7.6 to 8.2). In general most of the soils in Fulton county are strongly acid.

Soil drainage, as evaluated under Soil Series in this and other soil survey reports, has a very great influence on the color of soils. It also limits or determines the kind of crops or type of vegetation that may be found growing on any given soil or area. Most food producing plants or crops do best on well drained soils.

The combined influences of topography and geological erosion often determine soil depths and types of soil profiles that prevail over any given area. In general, shallow soils with the "A-C" type of profile, fig. 4, prevail in Fulton county wherever the land is steep because geological erosion has been removing surface soil material about as fast as it has been formed from the underlying rocks. In contrast, deep soils with the "A-B-C" type of profile prevail on the more level areas of the limestone valleys, the ridge tops of the shale hills, and the more level areas of high mountain plateaus.

In brief, soil environment is responsible for the final development of the soil as we know it. It is responsible for many soil characteristics of which the most important are: color, acidity or alkalinity, drainage differences, depth or kind and type of soil profile, presence or absence of large quantities of humus in the surface soil, and, last but not least, the inherent fertility or productive capacity of the soil.

CLASSIFICATION OF SOILS

All soils are similar in certain broad comparisons but like plants or animals each soil possesses one or more characteristics by which it can be identified. Once a soil has been studied and identified it can then be classified in accordance with the system of soil classification that was worked out for the United States by Dr. Curtis F. Marbut. This system provides for the classification of soils under six major subdivisions or categories, beginning with the broader category or "Order" and extending down through the "Sub-orders", the "Great Soil Group", "Soil Families", "Soil Catenas" and to the most complex which is the "Soil Series". In many comparisons this system is very similar to those which are used by scientists in classifying plants and animals.

When a soil series is first identified it is generally given a name taken from some nearby town, stream, mountain, or lake. Occasionally, county names are assigned to soil series. Soils, like people are identified by given names and descriptions.

"Soil Series," the Unit of Soil Classification in Fulton County

By definition a series category includes a number of soil characteristics of great importance to the classification and use of soils. In order that the reader may better appreciate the importance of the series unit of soil classification several of the more important series characteristics are outlined.

Mode of soil accumulation.—The process by which soil arrived at the position it now occupies. Briefly, the classification of accumulated soil material as found in Fulton county is:

Sedentary Soils — Soil material that never has been moved from its place of origin. This group includes *residual* and *cumulose* soils.

Residual Soils—Mineral soil materials derived in place from rocks or shales.

Cumulose Soils—Accumulations of organic materials, mainly peat and muck. None of these soils were found in Fulton county.

TRANSPORTED SOILS—Soil material transported to its present position by the forces of *frost and gravity, flowing water, moving ice, including snow,* and *winds.* No soils were found in Fulton county that were of wind origin.

Colluvial Soils—The forces of *frost* and *gravity* are reponsible for the movement, deposition, and development of extensive areas of colluvial soils on the lower slopes of most of the steep mountain areas in Fulton county.

Alluvial Soils—Flood waters are responsible for the transportation and deposition of the soil materials that comprise the alluvial flood plains and stream terraces.

(a) Stream Flood Plains or Bottom Lands. All the soils belonging to this group are subject to flood water overflow because they occupy the lowlands along streams.

(b) Stream Terraces. Stream terraces are nothing more than old alluvial deposits now well above any flood water overflows, except for extremely high flood water levels that occur possibly once in a century, an example being the flood in March of 1936.

Glacial Soils—Moving ice or glaciation has been of little importance in Fulton county. There may have been some soil material transported down mountain slopes by snow creep or snow slides during the ice age, but the total effect is not of great importance.

Kinds of geologic material from which the parent soil materials of Fulton county were derived.—

Kinds of Rocks	Geological Classification
Limestones:	
High purity	Trenton, Rodman, Lowville and Carlim
Cherty and sandy	Beekmanton
Very cherty and silicious	Lower Helderberg
Shales:	
Calcareous brown & yellow	Salina (Cayuga) and Clinton
Reddish brown to red acid	Mauch Chunk and Catskill
Dark drab or yellow gray acid	Portage, Genesee, and Hamilton
Brown and gray, acid	Chemung
Dark gray to nearly black, medium acid	Reedsville, Martinsburg and Marcellus
Sandstones:	
Brown or red, acid	Upper Mauch Chunk, Upper Catskill, and Juniata
Yellow brown to gray, acid	Pottsville and Oswego
Gray to nearly white, acid	Pocono, Oriskany and Tuscarora

Soil color—Color is one of the most important physical characteristics by which soils may be differentiated, compared, or classified. It is an important index as to the quantity of organic matter in soils, and it is also very useful in the study of soil drainage. Wet soils generally are mottled yellow, brown, blue, and gray. In Fulton county, the dark brown and brown soils are more productive than the yellowish brown or grayish brown soils.

Soil horizons and kind of type of soil profile.—If a soil is examined in cross section from the surface down to bed-rock, well developed layers or "Horizons" that differ in color, texture, or structure characteristics usually will be found. Capital letters are the index or identification symbols used in the identification of soil horizons.

Well developed and mature deep soils usually possess "A", "B" and "C" horizons. Immature or shallow soils may have only A and C horizons. Alluvial flood plain soils are so recent in origin that they have no horizons. Briefly, soil horizons may be described as follows:

A - HORIZON :—All of the original surface soil that has been subjected to the effects of climate, plants, and insects for thousands of years is included in horizon A. Much of the clay material has been moved to lower depths leaving the A horizon loose, mellow, and usually silty or sandy in texture. The thickness of this A horizon varies from 10 to 15 inches for most residual soils throughout south central Pennsylvania. Under natural forest vegetation most of the soil humus is concentrated in the surface portion.

B - HORIZON :—This is the zone of clay concentration. If present in a soil, it is found between the A and C horizons. It is a very important horizon for it retards leaching and the loss of plant nutrients from the soil. The most productive soils usually possess well developed B horizons.

C - HORIZON :—This horizon includes the lower parent soil material produced by the physical disintegration and chemical decay of rock materials. The C horizon usually contains less clay than the B horizon and larger quantities of unweathered rock or shale material than the A or B horizons.

The A - B - C type of soil profile is most frequently found on the more level areas where the soil depth usually exceeds 30 inches to parent rock. The A - C type of soil profile is found on steep slopes where geological erosion has not allowed the development of deep soils.

Soil reaction (acidity or alkalinity).—All the upland residual soils of Fulton county are from medium to strongly acid because they have been subjected to thousands of years of podsolic leaching. This type of soil leaching is most prevalent in humid cool regions where the soil is subjected to a continuous downward movement of rain water through the soil. As the rain water moved through the surface layers of decaying organic matter, it absorbed organic acids which were carried down into the soil where they exerted a powerful and severe leaching effect on the soil minerals. The podsolic leaching process is powerful enough to dissolve and leach practically all of the potassium, calcium and magnesium, and some of the iron from the surface soil. This type of leaching develops varying degrees of soil acidity. The most acid soils are those derived from sandstones. For the upland residual soils the Leetonia soil was the most acid and the Hagerstown, a soil derived from limestone residues, was found to be the least acid. The only alkaline soils in Fulton county are those of the Huntington, Lindside, and Melvin series which are

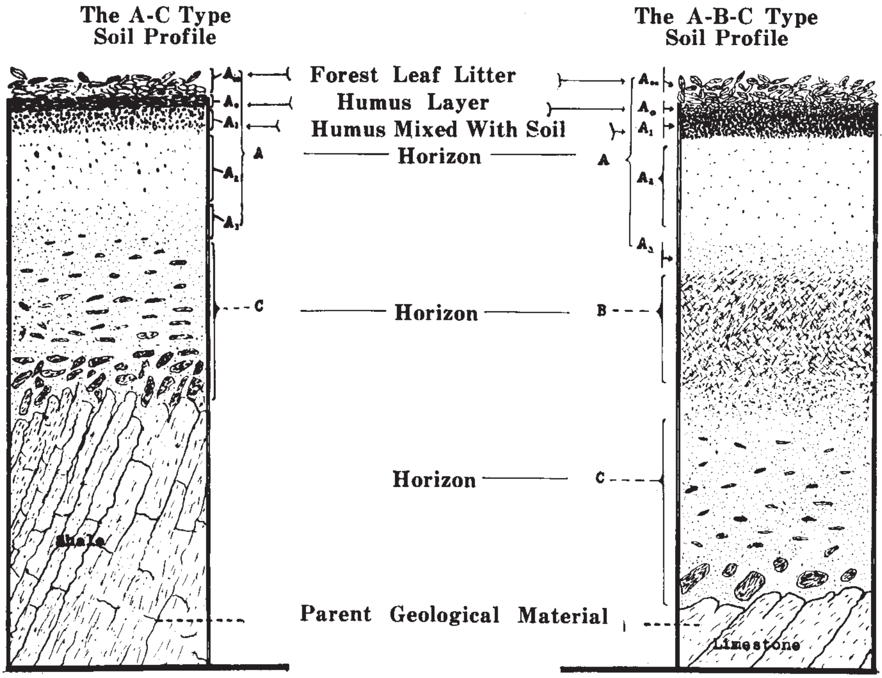

Fig. 4.—Generalized cross-section sketches of A-C and A-B-C types of soil profiles found in Fulton county.

alluvial flood plain soils found along streams flowing from limestone valleys.

Soil drainage classes.—Soil colors are very important indicators of soil drainage and fertility. Gray usually indicates either poor drainage or low fertility and possibly both. Yellow indicates intermediate fertility. Brown and dark brown or reddish brown indicate good drainage. In general, well drained soils are most productive. The color of soil material commonly varies from one soil horizon to another and it may differ within a horizon as it does in the A horizon.

Soil color is the basis by which soil drainage characteristics are evaluated and classified. The most important soil drainage classes are:

A. EXCESSIVE: — Water passes through excessively drained soil very fast, and the moisture storage capacity of such a soil is often poor. The soil color is usually brown, reddish brown, or grayish brown.

B. EXCELLENT:—Water percolates down through the soil rapidly. In general the moisture storage capacity of the soil is good. The A horizon is generally brown and the B horizon may be brown, yellowish brown, or reddish brown.

C. GOOD:—The downward movement of water is satisfactory in soil having good drainage. The moisture storage capacity of such a soil is excellent. The color of the A horizon ranges from brown to grayish brown. The B horizon is generally yellowish brown, and the C horizon may vary from brownish yellow to yellow.

D. IMPERFECT:—A soil is imperfectly drained if its A and B horizons have good drainage but its C horizon is frequently saturated with water during the rainy season. In general, the color of the C horizon of such a soil is mottled blue, gray, yellow, and rusty brown.

E. POOR:—The A horizon of a poorly drained soil often attains dryness but its color is usually yellowish brown to brownish gray, and it may be slightly mottled. The B and C horizons are often wet and usually are mottled blue, gray, yellow, and rusty brown.

F. VERY POOR:—The A horizon of a very poorly drained soil does not often dry out. The surface color of a very poorly drained soil is usually a very dark gray with intense mottling. The subsoil usually is permanently wet or saturated with water. The lower subsoil often has a bad odor.

G. PERMANENTLY WET TO SWAMPY:—Permanently wet soil remains wet throughout the year. This drainage class provides for the wettest soil condition capable of supporting plant growth on land. The color of the surface soil varies from a heavily mottled dark brown to nearly black.

H. MARSH:—In peat-bogs or swamps, the soil is often submerged and vegetation is limited to plants capable of growing in a very wet environment.

Practically all of these drainage conditions were found in the soils of Fulton county, but in general the swampy areas were too small to be shown on the soil map.

Structure or aggregation.—The structure and consistency of the soil in each horizon is always studied and evaluated, because soil structure and soil aggregation control to a large extent the rate of rainfall penetration or the rate of water movement into or through the soil.

Soil structure is also an index to soil tilth, the ease with which the soil may be plowed or cultivated. Structure also controls the amount of pore space that is available in the soil for plant roots, soil moisture, air, etc.

The preservation or development of good structure in the surface soil is a vital factor in the control of erosion, the object being to get the water into the soil rather than have it run off the land. Less run-off means more water stored in the soil for future plant needs.

Some of the more important structure classes for the soils of Fulton county are:

A. CRUMB STRUCTURE:—Soil having crumb structure is composed of irregular crumb-like aggregates. This ideal surface soil structure is often found in gardens, in grass sodland, or under the forest leaf litter in wooded areas.

B. SINGLE GRAIN STRUCTURE:—With single grain structure each soil particle behaves as a separate and single unit. Single grain structure is not desirable in cultivated soils. It tends to encourage erosion and retards water intake by soils. Hard rains encourage erosion; they "puddle" or "pancake" soils having single grain structure which become hard or crust over.

C. GRANULAR STRUCTURE:—When soil material is composed of sharp angular aggregates that have smooth glossy surfaces that are usually heavily coated with sticky colloidal clay materials, it is said to have granular structure. The aggregates are very stable and are best developed in the B horizon of the Hagerstown soils.

D. NUT STRUCTURE:—When a soil has a nut structure, it can be easily separated into subangular or roughly rounded aggregates that range from ½ to 1 inch in thickness. This structure is most commonly found in the B and C horizons.

Texture class.—This characteristic is determined by the percentage of sand, silt, and clay which a soil contains, and soils are classified accordingly. The class names for textures commonly found in the soils of Fulton county are sandy loam, silt loam, silty clay loam, silty clay, and clay. A class name refers to the texture of the surface soil, but in soil series descriptions the textures of all horizons or sub-horizons usually are indicated or included.

Topography.—The topographic position which a soil occupies is an important item in its use, because steep slopes when plowed

or cultivated may be subject to severe erosion, and flat level land may not have adequate surface drainage during wet periods.

Natural or native vegetation.—Vegetative cover exerts very important influences in soil development; therefore, in making a soil survey, the vegetative environment of each soil must be carfully studied and described under each series description.

Potential use.—The use capabilities and limitations of each soil are studied and evaluated during the progress of a survey. The results of these studies and observations are included under the description of each soil series.

In the detailed reconnaissance soil survey of Fulton county the classification of the soils was not carried beyond that of "Soil Series" separations. In detailed surveys there would be additional separations based on texture of surface soil, and possibly erosion phases, or other minor differences in accordance with their importance to the customary use of the land.

After Fulton county soils were classified as to soil series units, each series was given an official name as established by the United States Soil Survey Correlations Board of Inspectors, a group of men who devote their entire time to the study, classification, and correlation of the soils of the United States. A soil series name is a key name used in reference to a specific soil and all of its descriptive characteristics.

CLASSIFICATION AND DESCRIPTIONS OF FULTON COUNTY SOILS

After the soils of an area have been classified, they may be rearranged into groups or sub-groups having several similar characteristics, for example, on the basis of topographic features, stoniness, color, acidity, depth, drainage, or generalized use for agriculture, forestry, recreation or other purposes.

For convenience in the publication of the soil map of Fulton county, the soils were arranged in five major groups, each of which possesses certain generalized differences with respect to depth, stoniness, topographic position, fertility, and generalized agricultural use. They are:

I. Deep Soils of the Alluvial Flood Plains and Stream Terraces.

II. Medium Deep Upland Soils of the Limestone Valleys.

III. Medium Deep to Shallow Upland Soils Developed from Shale Materials.

IV. Shallow Droughty Soils of the Shale Hills.

V. Stony Soils of the Steep and Rugged Mountain Areas.

Soil Group I. Deep Soils of the Alluvial Flood Plains and Stream Terraces

The soils of the alluvial flood plains and stream terraces of Fulton county vary greatly in color, drainage, fertility, chemical reaction, mineral content, general use, etc. These variations can be further amplified under sub-groups and soil series descriptions. On the basis of color, reaction, and mineral content, these soils are divided into three sub-groups:

A. Very dark brown neutral to alkaline soils,

B. Reddish brown medium acid soils, and

C. Brown, yellow-brown, or gray-brown acid soils.

Sub-Group A. Very dark brown neutral to alkaline soils of the alluvial flood plains and stream terraces.—The soils as included under this sub-group have characteristic differences with respect to drainage and topographic position. These differences together with a number of others are given in each series description. In this sub-group the Huntington, Lindside, and Dunning series occupy the lower flood plains, and the Elk series occupies old high stream terrace positions.

The Huntington Soil Series

Origin of Soil Material: The soil material of the Huntington series is alluvial in origin. Most of this soil was transported to its present flood plain position by flood waters coming from the upland soils of the limestone valleys.

Development: This soil is of very recent geologic origin. It occupies both high and low flood plain areas, and it has not been in place long enough to have any soil profile development.

Description: This is a deep, well drained, neutral to alkaline alluvial soil. Normally the surface soil to a depth of 8 or 10 inches is a well-drained very dark brown neutral to alkaline loose mellow silt loam that can be plowed and cultivated with ease. The reaction may vary from faintly acid (pH 6.8) to mildly alkaline (pH 7.2), most areas being about neutral.

The subsoil is a well-drained, rich brown or dark brown, neutral to alkaline, open porous silt loam to silty clay loam where the soil is deep. On the lower flood plains the lower subsoil material below a depth of 2 feet may be sandy or gravelly. This is especially true of areas where stream flow is swift during flood periods.

Topographic Position: This soil occupies both high and low alluvial flood plains along streams that flow from limestone valleys and carry alkaline drainage waters.

Total Area and Location: The total area of this soil in Fulton county is very small, not more than 800 acres. It was found along Cove creek in the vicinity of McConnellsburg and Webster Mills, with another area along Tonoloway creek about 2 miles east of Warfordsburg.

Drainage and Erosion: The internal drainage of this soil to depths greater than 3 feet is good, but as mapped in Fulton county it may contain small areas of the Lindside soils which are imperfectly drained.

Surface drainage is usually very good, and as soon as flood waters subside excess surface water drains to the streams rapidly. Some areas of this soil are subject to considerable flooding during flood periods. Most of this soil is occupied by permanent pasture, mainly bluegrass and white clover, the sod of which protects the soil from flood water erosion.

Natural Vegetation: Trees commonly found on this soil are walnut, elm, sycamore, ash, beech, maple, hickory, and willow.

Natural Fertility: The natural fertility of Huntington soil is very high, probably the highest of any soil in the area except Lindside. Both surface and subsoil are well supplied with calcium and organic matter. Moisture reserves in this soil are excellent.

Current Uses: This soil is without question the most fertile and productive in Fulton county, and it will produce any crop that the climate of the region will permit. At present, most of this soil is used for the production of corn or pasture. In most places it is too fertile for small grain, because these crops when grown on highly fertile soils become top heavy and blow down

Fig. 5.—Bluegrass and white clover pasture on Huntington soil. This soil produces excellent pasture from early spring to late fall.

badly or "lodge" during heavy rains or wind storms. Then too, this soil occupies low damp areas where humidity is high. This favors plant diseases, and wheat or oats grown on these low areas often are attacked by rust. Much of this soil is used for white clover-bluegrass pasture because it retains moisture well throughout the summer; it continues to produce good pasture when pastures on the adjacent uplands become withered and wilted because of dry weather. An acre of this soil will produce sufficient pasture for a mature horse or cow throughout the summer grazing season. Corn yields vary but range from 50 to 90 bushels and average 50 to 60 bushels of shelled grain per acre.

Future Use Possibilities and Limitations: Because of its origin and position, this soil will continue to produce high yields of crops or pasture grasses for many years. It rarely ever needs additional lime. In most places it has a great reserve of organic matter, and where it is used for pasture the organic matter supply will be maintained or even increased. The texture of this soil ranges from sandy loam to silty clay loam, silt loam being the most extensive type. These textures promote easy tillage and the soil will respond very quickly to phosphorus and potassium fertilizer treatments.

The use of this soil is limited in many places by flood water overflows in early spring. Considerable washing out or silting under of crops occurs on some areas. This is the main reason as to why much of this soil is kept under pasture.

The Lindside Soil Series

Origin of Soil Material: The soil material of the Lindside series is alluvial. Most of it had its origin in the limestone valleys from where it was transported to its present position by flood waters.

Development: This soil is developed on low flood plains near streams that flow from limestone valleys. It is of very recent geologic origin and has no soil profile development.

Description: This is a deep, alkaline, alluvial flood plain soil having imperfectly drained subsoil.

To a depth of 8 or 10 inches this soil is very dark brown and neutral to alkaline in reaction. The texture of the surface soil ranges from sandy loam to clay loam, heavy silt and silty clay loams being the most extensive types. It has an unusualyy high organic matter content in the surface soil which can be plowed or cultivated easily under a wide range of moisture conditions. When cultivated or harrowed it breaks into a coarse granular

structure that provides good aeration and very rapid water intake during hard rains. The reaction of the surface soil ranges from pH 6.8 to pH 7.5 which means that the normal soil does not need lime.

The subsoil has what is termed imperfect drainage; that is, during wet seasons the ground water table may come to within 18 inches of the surface. Where the subsoil has been permanently saturated with water it usually has a mottled color pattern of rusty brown, yellow, and blue or gray. Mottled coloring indicates very poor subsoil drainage during wet seasons. During dry seasons, the soil is drained better, but the subsoil colors remain unchanged.

Few plant roots grow into soil that is saturated with water; therefore, the plant rooting zone is in the upper 2 feet of this soil except during dry seasons when the water table is lower.

Topographic Position: Most areas of this soil in Fulton county occupy low flood plains which are less than 10 feet above normal stream levels.

Total Area and Location: The total area of this soil in Fulton county is less than 100 acres. The largest accumulation is on Cove creek northwest from Webster Mills.

Drainage and Erosion: Because of its low flood plain position, this soil is subject to frequent flood water overflows. Surface runoff after flood periods is rapid and satisfactory for most areas. Flood waters rarely ever erode this soil, but they may leave new alluvial deposits over the flooded areas. This soil series as mapped contains some rather poorly drained spots that would be classified in the Melvin series on detailed survey maps.

Natural Vegetation: The natural vegetation was hardwoods consisting of hickory, beech, maple, and willow trees with some cat-tails and swampland sedges in the wetter areas.

Natural Fertility: Lindside soil is very well supplied with all plant nutrients and has very high organic matter reserves.

Current Use: A few areas are used for corn but this soil is most productive when occupied by permanent pasture—mainly bluegrass and clover.

Future Use Possibilities and Limitations: The natural fertility and organic matter reserves of this soil are very high; therefore, the problem of maintaining fertility is relatively unimportant except for possible additions of phosphorus fertilizers when grasses and legumes for hay or pasture are grown.

Some areas may be improved by tile drainage or deep open ditches provided there is sufficient grade to allow for the rapid removal of drainage water from the wetter areas.

The Dunning Soil Series

Origin of Soil Material: Dunning soil material is alluvial in origin, being a composite transported from shale and limestone valleys. Occasionally areas may be influenced by colluvial deposits from nearby uplands.

Development: This soil is deposited on low alluvial flood plains where alkaline underground water gives the subsoil an alkaline reaction. In many places the surface soil may also be alkaline but it usually is from medium acid to neutral, pH 6.5 to pH 7.0.

Description: It is a very dark brown to nearly black alluvial soil having imperfect to poor subsoil drainage.

The surface soil in most places is a very dark brown to nearly black, rather heavy textured material that possesses considerable plasticity when wet. When dry it shrinks, giving rise to open cracks and clods. Farmers often say the soil is "gummy" when moist and "hard" when dry. This soil does not possess as good tillage qualities as the Huntington and Lindside soils. It occupies very low areas where surface drainage is not too good.

The subsoil from 10 inches down is a rather heavy plastic silty clay to clay that has both imperfect to poor drainage and restricted air circulation even when the water table is low during the dryer seasons of the year. Below 10 inches, the soil is mottled blue-gray and yellow, indicative of poor drainage and poor aeration.

Topographic Position: Dunning soils are found on very low flood plains near small streams.

Total Area and Location: The total area of this soil in the county is less than 100 acres and the largest area of any importance is on Licking creek about a mile south of Knobsville. Other areas of this soil have been found in Bedford county, along Dunning creek from which the soil received its name.

Drainage and Erosion: This soil occupies the slack water areas of low flood plains, therefore, it is subject to flood water overflows. The major drainage problem is the removal of excess surface and subsoil water after hard rains or floods. Diversion ditches and open ditches for carrying water to streams would improve surface drainage of this soil.

Natural Vegetation: Elm, sycamore, maple, beech, and willow trees composed in part the natural vegetation found on Dunning soils.

Natural Fertility: The natural fertility of this soil is high but its physical characteristics are less desirable than those of the Huntington and Lindside soils.

Current Use: At the present time most of this soil in Fulton and Bedford counties is devoted to pasture, composed of white clover and bluegrass. A small portion is devoted to corn production even though planting dates are often delayed in spring by excess moisture in the soil.

Future Use Possibilities and Limitations: This soil, because of its origin, position, and internal drainage can best be utilized in the production of permanent pastures. It is too black and heavy for crops like potatoes, alfalfa, red clover, small grains, or even corn in some places. The physical condition of the surface might be improved by improving drainage. Since Dunning soil occupies low areas into which cold air drains at night, it should be devoted to those crops that tolerate high humidity and cool night temperatures. Pasture grasses thrive under such conditions.

The Elk Soil Series

Origin of Soil Material: Soils of the Elk series are found in Fulton county in alluvial flood plain deposits that occupy terraces along streams that flow from the limestone valleys.

Soil Development: This soil is found in close association with the Huntington, Lindside, and Dunning series. Elk soils have been in place long enough to show very faint development of A-B-C horizon type profiles.

Description: The surface soil to a depth of 12 or 15 inches is brown in color. The subsoil is yellowish brown to brownish yellow, indicating good drainage. In plowed fields the surface soil may be grayish brown when dry, indicating less organic matter in the plowed soil than in the same soil under forest cover.

Topographic Position: Soils of the Elk series occupy old, high stream terraces.

Total Area and Location: The total area in Fulton county is less than 100 acres. It is found in small areas along Cove creek. Most of these areas were too small to be shown on the soil map.

Drainage and Erosion: The surface and subsoil drainage of this soil is very good. A few areas may be subject to some surface erosion.

Natural Vegetation: The predominant tree growth found on this soil was red oak, white oak, walnut, hickory, hackberry, elm, maple, and locust.

Natural Fertility: The natural fertility of this soil is lower than that of the Huntington, Lindside, or Dunning series, for it has been in place longer and has leached more. The reaction of the surface soil and subsoil is mildly acid, pH 6.5.

Current Use: Due to smallness of the areas, most of this soil on the basis of use is combined with Huntington soils. Occasionally small areas of the Elk soils are set aside for special truck crops, potatoes, etc. This soil is deep, fertile, and well drained. It has excellent moisture storage capacity that is valuable to crops during droughty periods.

Future Use Possibilities and Limitations: The areas of this soil in Fulton county are too small to be of any great significance, but if they were sufficiently large, they would be the most valuable crop soils in the county.

Sub-Group B. Reddish brown medium acid soils of the alluvial flood plains and terraces.—The parent soil materials from which the different soils in this sub-group are developed are all of alluvial origin and were transported from the soils that occupy the red shale areas of the county. In this group the Moshannon and Senecaville soils occupy the low flood plains, and the Cassville soil occupies the higher stream terraces.

The Moshannon Soil Series *

Origin of Soil Material: This acid, reddish brown, alluvial soil was transported to its present low flood plain position by flood waters from Lehew and Calvin soil areas.

Development: This soil is of very recent geologic origin and has not been in place long enough to have any soil profile development.

Description: The surface soil is a rich reddish brown and is loose and mellow. The surface texture varies from sandy loam to silt loam but for most areas it is a loose mellow loam. The soft fine crumb structure of the surface soil is not well defined or well developed. The organic matter content of the surface soil is considerably lower than that of the Huntington soil. The surface soil reaction is medium acid, pH 5.5 to 6.5, with most of the areas being less acid than pH 6.0.

The subsoil from 15 inches downward is either reddish brown or yellowish brown. Subsoil drainage is very good and for some areas it may be excessive if the content of gravel in the lower subsoil is too great; however, the good drainage of the subsoil encourages the deep rooting of plants. The texture of the subsoil is in most places about the same as that of the surface soil, but along smaller streams the lower subsoil contains large proportions of sand and gravel.

* Recent soil studies and correlations have established a new series name, Cacapon, for this soil and the name Moshannon will be confined to the more alkaline and reddish brown alluvial soils in the Ohio river valley. The Cacapon series will be confined to the Appalachian ridges and valleys.

Topographic Position: Moshannon soils are found on low alluvial flood plains.

Total Area and Location: The total area of this soil in Fulton county is approximately 3,000 acres, the most of which is along Licking creek, Bridge creek, Brush creek, and the upper tributaries of Tonoloway creek.

Drainage and Erosion: Normally, Moshannon soils have excellent surface and subsurface drainage. They are subject to seasonal flooding when streams overflow their banks, but as soon as the streams return to their channels the water drains from the soil rapidly.

Natural Vegetation: Moshannon soil was originally occupied by a forest cover containing red oak, white oak, elm, sycamore, maple, ash, willow, and other hardwoods.

Natural Fertility: The natural fertility of Moshannon soil is below that of the neutral to alkaline flood plain soils, but above that of most of the upland residual soils. The total organic matter reserves in Moshannon soil are comparatively low. This soil would have a higher natural fertility level if it contained more lime and organic matter.

Current Use: Except for areas occupied by weeds and trees next to the streams, this soil is all used for the production of important agricultural crops, mainly corn, hay, potatoes, and pasture.

Corn yields range from 40 to 70 bushels and average around 60 bushels of shelled grain per acre. Potato yields vary greatly

Fig. 6.—Alluvial flood-plain soils along Sidling Hill creek below Waterfall, northern Fulton county. The wheat field is located on the Moshannon soil. Gilpin (Ashby) soil occupies the shale hills in the background.

depending on the amounts and kinds of fertilizers used, but under ordinary farm practices they range from 100 to 200 bushels per acre. These yields can be greatly increased where large amounts of manure and fertilizers are applied. Clover hay yields range from 1½ to 2 tons per acre per year.

Future Use Possibilities and Limitations: Moshannon soils have natural deficiencies of lime, phosphorus, and potassium. By the addition of lime and fertilizers, these soils can be kept in a high state of productivity for many years. Cropping systems should include grasses and legumes that will aid in building up the organic matter reserves in the soil. Their best future use will no doubt be for the production of corn, clover hay, some small grain, potatoes, and other special crops that demand deep, loose, mellow, and well drained soils. In Bedford and Blair counties, some areas of Moshannon soils have been used for commercial vegetable production with considerable success.

The Senecaville Soil Series

Origin of Soil Material: This acid, reddish brown, alluvial soil was transported to its present low alluvial flood plain position by flood waters from the acid, residual, upland soils derived from acid red shales and sandstones.

Development: This soil is of very recent geologic origin and has not been in place long enough to have any soil profile development.

Description: The surface soil to a depth of 8 or 10 inches is a rich, dark, reddish brown to brown, loose, mellow silt loam or loam that is reasonably well drained and medium acid in reaction, pH 5.75 to 6.50. The subsoil has imperfect drainage, giving rise to a mottled brown, blue, yellow, and gray subsoil. In late winter and early spring wet periods, the water table may rise to within 10 or 15 inches of the surface, and during dry periods it may be lowered to 4 or more feet. The height of the water table in the soil is often controlled by the level of the water in the adjacent or nearby streams.

This soil as mapped includes a number of poorly drained areas which in detailed soil mapping would be classified under separate series. The surface soil of these poorly drained areas is of a rusty brown, blue, gray, and yellow mottled color.

These poorly drained areas are easily located because they usually support a growth of wet land sedges that often appear more or less bunched rather than in uniform stands.

Topographic Position: The Senecaville soils occupy alluvial flood plains along streams flowing from the acid red shale hill areas of south-central Pennsylvania.

Total Area and Location: The total area of this soil as mapped in Fulton county is approximately 800 acres, the majority of which is located along the upper branches of Sidling Hill creek in the northwest corner of the county. Other small areas are found where Little Tonoloway creek flows through the gap in Sidling Hill mountain and along Wooden Bridge creek which is near the Pennsylvania turnpike.

Drainage and Erosion : Because of its low position along streams, this soil is subject to frequent flooding, and in many places the surface runoff is slow, and water may stand on some areas until it drains down through the soil. A few areas of this soil are subject to erosion but many areas receive additional silting from flood waters.

Natural Vegetation: Natural vegetation found growing on this soil was mainly elm, beech, maple, hickory, willows, hemlock, and other trees that tolerate wet soils.

Natural Fertility: This soil possesses a rather high fertility that will endure for many years.

Current Use: Practically all of this soil is either used for pasture or is left under natural vegetation. The use of this soil for cultivated crops is hazardous because of its low position and susceptibility to frequent flood water overflows.

Future Use Possibilities and Limitations: Most areas of this soil are located in deeply entrenched narrow mountain valleys which fill with cold air at night. This condition tends to shorten the growing season for certain crops. It also favors frosts in late spring and early fall. In general, the best use for much of this soil is improved permanent pastures and meadows. Some areas may be improved by applying sufficient lime to neutralize soil acidity and adding from 200 to 300 pounds of superphosphate per acre about once every 4 years.

The Cassville Soil Series

Origin of Soil Material: Cassville soil is derived from acid, reddish brown, alluvial soil material and was transported to its present location by flood waters flowing from acid, red shale hill areas.

Topography: This soil occupies old stream terraces along and adjacent to the more recent alluvial flood plain deposits. All areas of this soil are well above flood water overflow from nearby streams.

Regional Soil Development: This soil has been in place long enough to have a very slight development, of A and B horizons.

Description: Cassville is a deep, alluvial, terrace soil. The total depth of the soil ranges from 4 to 10 feet and averages about 6 feet. The surface soil is a light brown to brown, loose, mellow, silt loam to loam that has a weakly developed fine crumb structure. At the 8-to-12-inch depth the color of the surface soil becomes yellowish brown. The surface soil is medium acid in reaction, pH 5.25 to 6.25. From 15 to 18 inches and downward the soil is a yellowish brown to brown, heavy, silt loam, and if examined under moist conditions it possesses a weakly developed structural aggregation, which may be separated into aggregates that range from ¼ to ¾ inches in thickness. The subsoil is medium acid, pH 5.5 to 6.5.

Where this soil has been used for crop production for years and the organic matter supply has become low, the surface soil in plowed fields may be grayish brown when dry.

Total Area and Location: The total area of this soil in Fulton county is approximately 600 acres. Most of it is located on high stream terraces along Licking creek in the southern end of the county.

Surface Drainage and Erosion: The surface water runoff rate for this soil is rapid, and at the edges of some of the terraces there is considerable gully erosion. This is very valuable soil and its future use should be safeguarded by erosion control measures.

Natural Vegetation: Native trees, mainly hardwoods, such as red oak, white oak, maple, hickory, elm, cherry, beech, birch, walnut, etc. comprised the natural vegetation of this soil.

Natural Fertility: The natural fertility of this soil is a little lower than that of the Moshannon series which is its low flood plain associate. The surface soil is leached more, it is a little more acid, and it contains less organic matter than Moshannon soil. Cassville soil has good physical properties and responds quickly to good management, lime, and fertilizers.

Current Use: Approximately 90 per cent of this soil has been cleared and used for crop production. Most of it is used for corn growing because the soil is deep and it has good moisture storage capacity. Corn yields range from 35 to 70 bushels of shelled grain per acre. Small grain crops grown on this soil are mainly wheat and oats. Wheat yields range from 15 to 35 bushels per acre. Red clover and timothy are an important hay crop with yields from 1 to 2 tons per acre. Potatoes may be grown on this soil with considerable success if liberal quantities of manure and fertilizer are applied.

Future Use Possibilities and Limitations: Cassville soil, if properly managed, will continue to produce general farm crops for many years. It should be protected from erosion and every effort possible should be made to maintain or increase soil organic matter by the use of sod crops and manure. Lime and fertilizer can be applied to advantage on this soil since it will respond to good management practices.

Sub-Group C. Brown, yellow-brown, or gray-brown acid soils of the alluvial flood plains and stream terraces.—The soils of this group are all developed from acid, alluvial materials transported from the brown, yellow-brown, and gray-brown, acid, residual upland soils derived from acid sandstones and shales. The series separations within this group of soils are primarily based on topographic positions occupied by the soil together with the different drainage environments of each soil.

The Pope Soil Series

Origin of Soil Material: Pope soil is alluvial material transported by flood waters from acid upland residual soils derived largely from acid sandstones and shales.

Topography: This soil occupies low flood plains which are subject to seasonal overflow by stream flood waters.

Development: This soil has developed where soil drainage environment is good.

Description: It is a deep, well drained, acid, alluvial flood plain soil. The surface to a depth of 8 to 10 inches is in most places a yellowish brown to grayish brown, loose, mellow, acid silt loam. The organic matter supply of the surface soil is about average for flood plains in this region. The amount of stone or gravel that may be present varies greatly, depending on the location of the area. In Fulton county, most of the Pope soils along the larger streams are relatively free of stone or gravel but for those areas along the small streams that flow through narrow mountain valleys, the quantity of gravel and stone may be great enough to discourage plowing and cultivation.

The subsoil of the Pope series is brownish yellow in color to a depth of 3 or more feet. Where the soil is well drained, and deep, the subsoil may be yellowish brown. Under such conditions, plant root penetration into the lower subsoil is never restricted because of poor drainage. On the lower flood plains, the Pope soils may be underlain by sand and gravel beds which provide very rapid subsoil drainage, which promotes rapid removal of excess soil water following flood periods.

Total Area and Location: The total area of Pope soil in Fulton county is approximately 400 acres, the most of which is along Tonoloway and Aughwick creeks.

Drainage and Erosion: This soil occupies stream flood plains where it is subject to occasional flooding by stream overflows. The period of flooding is usually of very short duration. Water rarely ever stands on the soil long enough to kill crops. Surface and subsoil drainage is rapid and erosion for most areas is unimportant.

Natural Vegetation: Natural vegetation was mainly hardwoods. Oak, beech, maple, hickory, elm, sycamore and some hemlock grew near the mountains. Tulip poplar and the cucumber tree are often found growing on this soil.

Natural Fertility: This soil possesses very excellent physical qualities but does have lime, phosphorus, and potassium deficiencies.

Current Use: Approximately three fourths of this soil is cleared of natural vegetation and is now used for the production of crops. Corn is the major crop, and yields vary from 40 to 70 bushels per acre depending on soil conditions and amounts of fertilizer applied.

Future Use Possibilities and Limitations: The best use of this soil will probably be for corn and pasture production because it is subject to stream overflow which might be damaging to small grain crops in early spring or summer.

Maximum production is limited by fertility rather than physical conditions. The productivity of this soil can be increased by good soil management practices together with additions of lime and fertilizer.

The Philo Soil Series

Origin of Soil Material: The Philo soils are composed of material transported by flood waters from acid, upland, residual soils derived from yellow and gray, acid sandstones and shales.

Topography: This soil occupies low flood plains which are subject to seasonal overflow.

Development: This soil is developed on low flood plains where the internal subsoil drainage is imperfect. In winter and early spring, the subsoil is very wet; in summer the water table lowers and allows only temporary improvement in subsoil drainage.

Description: It is a deep, acid, alluvial, flood plain soil.

Fig. 7.—Permanent pasture on Philo soil.

The surface soil of the philo series is brownish gray to dark grayish brown to a depth of 6 or 8 inches, below which the color, because of reduced air circulation, becomes more yellow. The surface soil texture ranges from a sandy loam to a clay loam, the dominant textures being silt loam and silty clay loam. When wet the surface soil becomes somewhat sticky and plastic, and when it dries it shrinks enough to cause small checks or cracks to develop downward into the soil. The surface soil is everywhere strongly acid, pH 5.0.

Below 15 or 18 inches, the subsoil is a mottled yellow or yellowish gray and rusty brown, heavy, silty clay to clay. When wet it is plastic and sticky, and when dry it becomes hard and impervious. It isn't a very good medium for plant roots because when it is wet the roots may die because of lack of air, and when dry the roots are surrounded by hard, impervious soil material. The subsoil is strongly acid, pH 5.0 to 5.5.

Total Area and Location: The total area of this soil in Fulton county is approximately 2,000 acres. The largest areas are found along the small streams that flow from areas of Gilpin soil.

Surface Drainage and Erosion: This soil occupies low flood plains. It is subject to frequent flood water overflows. Surface drainage is rather slow. This together with the slow downward movement of water through the subsoil gives rise to wet soil conditions after heavy rains.

Natural Vegetation: The natural vegetation found on this soil was hardwood forest that contained oaks, elms, beeches, maples, hemlocks and willows.

Natural Fertility: The organic matter reserves of this soil are about average for the flood plains of the region, but the soil is strongly acid and is deficient in lime, phosphorus, and potassium.

Current Use: About one third of this soil is occupied by native hardwood trees. The remainder has been cleared and used mainly for pasture. Some of the larger and better drained areas are often used for corn or hay production. The hay crops are combinations of alsike clover and timothy. Corn planting is often delayed in spring because of cold wet soil conditions until the middle of May.

Future Use Possibilities and Limitations: The two major factors that limit the use of this soil are flood hazards and slow internal drainage. Areas of this soil are usually confined to narrow accumulations between steep hills on one side and winding streams on the other. These conditions in general restrict its use to pasture or hay, but some of the larger areas may be used for growing corn. The productivity of the soil can be improved by surface drainage. Diversion ditches located between this soil and adjoining uplands in some places would intercept runoff water from higher elevations and divert it directly into streams or around fields instead of allowing it to spread out over and saturate entire flood plains. Liberal applications of lime and fertilizer are essential for maximum production of pastures or other farm crops grown on Philo soils.

The Atkins Soil Series

Origin of Soil Material: This is an alluvial soil, developed from materials transported by flood waters from acid upland residual soils that were derived from acid gray and yellow sandstones and shales.

Topography: This soil occupies low flood plains which are subject to seasonal flood water overflows.

Development: Atkins soil is developed from alluvial sediments coming from slow moving flood waters. It occupies a wet poorly drained environment and as mapped it includes a few areas that may be considered swampy.

Soil Descriptions: It is a poorly drained, acid, alluvial, flood plain soil. The surface soil is either gray or very dark gray in color to a depth of 6 or 8 inches. Below the 3-or-4-inch depth, the

soil possesses a mottled gray, blue, yellow, and rusty brown color. Below 8 or 10 inches, the internal drainage ranges from very poor to permanently wet.

The subsoil is a mottled rusty brown, blue, gray, and yellow tough plastic or putty-like clay which is usually saturated with water except during the dry months of mid-summer.

Total Area and Locations: The total area of this soil in Fulton county is not over 100 acres and the largest plot is near Knobsville. Many smaller areas are included with the Philo series because they were too small to be accurately shown on the soil map.

Surface Drainage and Erosion: There is no erosion because this soil is so poorly drained. It is subject to frequent floodings and the runoff rate for surface water is very slow.

Natural Vegetation: The natural vegetation found on this soil was mainly swamp land sedges, hemlocks, and willows.

Natural Fertility: Fertility is low because of poor drainage and strong soil acidity.

Current Use: Use of this soil is largely confined to pasture grasses that tolerate wet swampy soils.

Future Use Possibilities and Limitations: Its future use will be mainly forest with occasional areas of hay or pasture grasses that will tolerate wet, acid soils.

The Holston Soil Series

Origin of Soil Material: The Holston series is composed of alluvial flood plain soil transported from acid residual soils derived mainly from acid sandstone and shales.

Topography: The Holston soil occupies elevated terraces and may be from 30 to 500 feet above present stream levels.

Development: This soil material has been in place long enough for the development of a very youthful A-B-C soil profile with good aeration and drainage in all horizons.

Description: It is a deep, well-drained, acid, alluvial soil, developed on stream terrace positions. The surface of the Holston series to a depth of 6 or 8 inches is a brown, grayish brown, or yellowish brown, acid, loose mellow soil, the texture of which ranges from sandy loam to silt loam. In Fulton county the dominant texture is silt loam. Areas of this soil found near mountains often contain varying quantities of gravel, cobble stone, or even larger stone. Below 8 inches the surface soil contains but little organic matter and because of this the soil color is generally brownish yellow or yellow.

Below the 15-inch depth the soil is yellowish brown in color, and its reaction is acid, pH 5.0 to 5.5. It is firm but not compacted. It is sufficiently open and porous to permit good plant root penetration and rapid movement of water down through the soil. The texture of the subsoil varies greatly but for most areas it ranges from sandy loam to silt loam. In the broad valleys the content of gravel and stone in the soil is very low, but when this soil occurs near the mountains, the quantity of gravel and stone increases to where it becomes a factor in the use of the soil. Except for the gravelly or stony areas, the Holston soil has excellent physical qualities. It can be plowed and cultivated easily, and when loosened by plowing or cultivation it resists the puddling or packing effects of hard rains.

Total Area and Location: The total area of Holston soil in Fulton county is not great, probably not more than 200 or 300 acres. Most of the areas were too small to be shown accurately on the soil map, but many small areas were found in very close association with the Pope, and Philo soils along Licking creek, Little Aughwick creek, and the larger tributaries of these streams.

Drainage and Erosion: The surface drainage of this soil is very good, but on the edges of these small terraces the rate of water runoff may be fast enough to cause appreciable sheet and gully erosion.

Vegetation: This soil originally supported giant hardwoods containing red oak, maple, hickory, ash, elm, and other trees that demand deep, fertile, and well-drained soils.

Fertility: The physical characteristics of this soil are ideal for plant growth but it is deficient in chemical nutrients, mainly calcium, phosphorus, potassium, and possibly others. To obtain maximum production of crops, the use of lime and fertilizers is essential.

Current Use: All areas of this soil that do not contain stone or gravel in quantities that prohibit plowing or cultivation are cleared and used for the production of corn, small grains, hay, and potatoes.

Corn yields vary but for average conditions they range from 40 to 60 bushels of shelled grain per acre.

Future Use Possibilities and Limitations: The physical condition of this soil is favorable to the production of many crops but corn, small grains, hay, potatoes, and possibly truck crops will probably be the major crops grown on it in the future.

The Monongahela Soil Series

Origin of Soil Material: The Monongahela series was derived from alluvial flood plain soil material transported from acid, residual upland soils derived mainly from acid sandstones and shales.

Topography: This soil occupies elevated stream terraces which range from 30 to 500 feet above present stream flow levels.

Development: This soil is developed on rather flat to level terrace positions where subsoil drainage conditions are imperfect.

Description: It is a deep but imperfectly drained, acid, alluvial terrace soil. The surface soil to a depth of 6 or 8 inches is a dark grayish brown to dark gray, acid heavy silt loam to silty clay loam. The drainage of the surface soil is often restricted after heavy rains because of the slow downward movement of water through the subsoil.

The subsoil from 15 inches down is a rusty brown, yellow, blue and gray mottled, silty clay material that is rather sticky or plastic when wet. Water movement through the subsoil is generally slow when the clay is wet. The subsoil is strongly acid, pH 5.0, and it possesses but little structural aggregation.

Total Area and Location: The total area of this soil in Fulton county is less than 300 acres. The largest areas are along Tonoloway, Licking, and Little Aughwick creeks.

Surface Drainage and Erosion: This soil occupies rather flat level terraces where surface drainage or runoff is relatively slow. Naturally there is little or no surface erosion. With a slow downward movement of water through the soil, there are times after heavy rains when water may stand on it.

Natural Vegetation: Oak, hickory, beech, maple, and gum trees were the natural cover of this soil.

Natural Fertility: It is low in fertility. The soil is strongly acid and deficient in lime, phosphorus, nitrogen, and potassium. Possibly other elements are lacking.

Current Use: It is used mainly for hay and pasture with corn being more important on the better drained areas. Frost "heaving" causes serious winter injury to crops that occupy this soil in winter. It warms up slowly in spring because of the sluggish movement of soil water following thaws and heavy rains.

Future Use Possibilities and Limitations: The best future use for this soil will probably be for the production of hay and

pasture crops except where both surface and subsoil drainage conditions have been improved by the installation of either open ditches or tile drains. Investments in tile drainage are questionable except for areas that will be devoted to intensive use, such as gardens, building sites, etc.

The Tyler Soil Series

Origin of Soil Material: The Tyler soils were developed from old alluvial flood plains that were deposited by rather slow moving flood waters. The soil material originally came from residual upland soils that were derived from sandstones and shales.

Topography: This soil occupies elevated stream terraces where surface topography is nearly level.

Development: The Tyler soils are developed where surface runoff and downward movement of water is slow. The drainage environment is poor.

Description: Tyler soils are poorly drained, acid, alluvial terrace soils. The surface soil is a yellow, gray, and rusty brown mottled silt loam to a depth of 8 or 10 inches. Below this depth, the subsurface soil becomes yellow and gray mottled, indicating restricted circulation of air and poor drainage. This soil, because of its slack water origin, contains but little if any gravel or stone.

Below 12 or 14 inches, the subsoil is a yellow or blue gray, rather heavy, plastic silty clay or clay. This material, when wet, has a tough putty-like consistency, which restricts the downward movement of water through the soil after heavy rains.

Total Area and Location: The total area of Tyler soil in Fulton county is not more than 200 acres. Most of this is found in small deposits associated with the Monongahela soils. The largest area is near the town of Needmore.

Surface Drainage and Erosion: The surface drainage and rate of water runoff of this soil is rather slow, and after heavy rains it remains wet for several days because the percolation of water downward is slow.

Natural Vegetation: Hemlock, gum, and hardwoods were found growing on the Tyler soils.

Natural Fertility: The soil is both acid and wet. It is also deficient in lime, phosphorus, potassium, and perhaps several other important plant nutrients.

Current Use: Most of this soil at present is used for either pasture, hay, or natural forest. Where surface drainage has been

improved by the installation of open ditches, some of the better drained areas have been used for corn.

Future Use Possibilities and Limitations: With surface and subsoil drainage conditions poor, the future use of this soil is definitely limited to those crops or pasture grasses that tolerate wet soils. Where surface drainage can be, or is provided, the yield and quality of pasture or hay can be improved by first liming this soil to neutralize soil acidity and then applying fertilizers to increase its fertility.

Soil Group II. Medium Deep Upland Soils of the Limestone Valleys

The soils of this group are without question the most fertile and most productive upland soils in the county. They are for most areas deep, and because of this they absorb and retain large quantities of water. The underlying limestones are exposed at steep angles, which allows water to enter the rocks and other underground cavities rapidly thereby providing good subsoil drainage. Under natural forest, the trees absorbed, direct from the limestones, large amounts of calcium which was returned to the soil each year when the leaves fell. This aided greatly in building up and preserving a rather high fertility level in this group of soils.

Some of the soils in this group, the Hagerstown, Frankstown, and Elliber series, are primarily developed from residual materials derived from limestones. The other soils, the Murrill and Buchanan series, are developed from colluvial or transported materials that overlie residual materials derived from limestones or shales. All of the soils in this group, because of their fertility and depth, are important agriculturally.

Sub-Group A. Residual soils overlying limestones.—The differences that are found in this group of soils are inherited from the parent limestones. Some limestones are of high purity and when weathered they give rise to silt and clay residues.

Other limestones when weathered give rise to soils that are more sandy and which contain large quantities of chert or flint. These differences are described in the following series descriptions.

The Hagerstown Soil Series

Origin of Soil Material: The parent materials of this important soil are the residual products produced by the chemical disintegration of limestones of comparatively high purity.

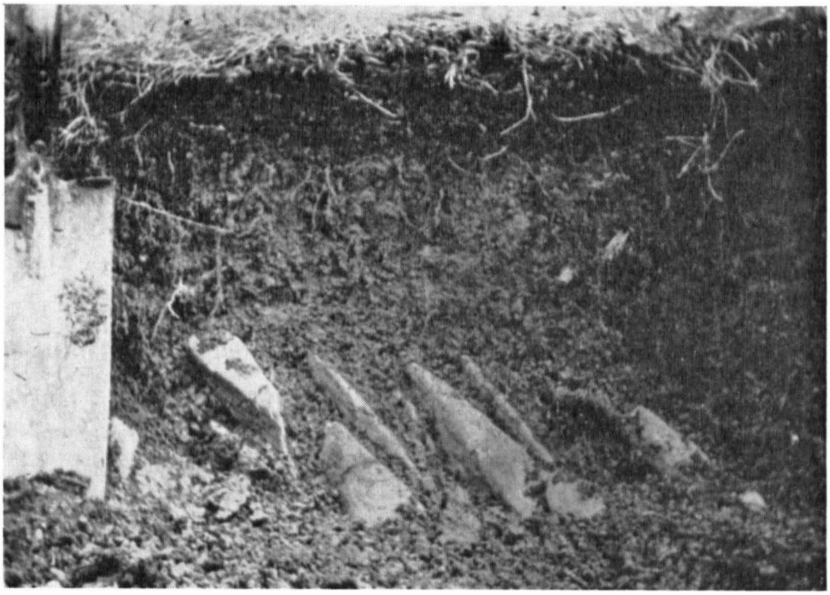

Fig. 8.—Hagerstown soil in vertical cross section. Notice the surface soil is enriched with soil humus to a depth of 6 inches. The soil at this site was occupied by trees and grass and never had been plowed.

Topography: The Hagerstown soils are developed over massive beds of limestones that are usually exposed at steep angles. These limestones weather down unevenly and give rise to what may be called smooth to rolling uplands of the limestone valleys. The relief in many places is of the "Karst" type in that here and there the edges of limestone formations protrude giving rise to what has been called "limestone reefs." In addition, the land surface is often uneven because of numerous depressions or "sinks".

Development: The soil developing processes normal to this region have developed from the residual soil materials derived from limestones, a brown to grayish brown forest soil in which the A, B and C horizons are clearly defined.

Description: Normally this is a relatively deep soil but it contains numerous shallow areas. The depth varies from only a few inches to 10 or more feet, much of this soil being 3½ to 4 feet deep.

General description of Hagerstown soil as found under forest cover:

A_{00} Litter layer—the forest litter is composed mainly of leaves from red and white oak forest. In thickness the litter ranges from ½ to ¾ inch when pressed down by the weight of snowfall.

A_0 Humus layer, 0 to ½ inch—This layer is composed of a loose, mellow, very dark brown, faintly acid to alkaline humus that possesses a fine crumb structure. When moist it has a velvety, spongy feeling and is alive with insects, earthworms, fungi, and bacteria. It is an excellent medium for seed germination.

A_1 Horizon, ½ to 2 inches—This horizon consists of loose, dark brown, mellow silt loam that has an open and porous, fine crumb structure. The soil minerals are heavily stained and coated with soil humus. This layer provides a very excellent medium into which the roots of young plants may grow and absorb nutrients. The reaction of this horizon is slightly acid, pH 6.75 to 7.0.

A_2 Horizon, 2 to 12 inches—The upper portion of this horizon is yellowish brown, but as depth increases the color changes to brownish yellow indicating strong leaching throughout this horizon. The quantity of humus in this layer is very low. The texture of the soil in this horizon varies from silt loam to loam that possesses little structure development. The soil is open, porous, and well drained. Moisture movement is rapid in all directions. Aeration is good and plant roots are uniformly distributed throughout this layer. The reaction of this horizon is acid, pH measurements ranging from 5.5 to 6.25 and averaging about 5.75.

A_3 Horizon, 12 to 15 inches—This is a transition layer between the A and B horizons. It is slightly less acid than the A_2 layer, and it is more brown in color. It usually is a heavy silt loam to silty clay loam in texture, and it possesses a soft incoherent coarse crumb to granular structure.

B_1 Horizon, 15 to 30 inches—This horizon is a rich brown to reddish brown, coarse granular, silty clay to clay. The soil material when moist can be separated easily into a mass of coarse angular aggregates. The surfaces of these aggregates are heavily coated with colloidal films which when wet are sticky and cause the soil to stick together. The aggregates in this horizon are always sharp angular, and range from ⅛ to ⅜ inches in thickness. The reaction of this layer is medium acid, pH 5.75 to 6.5, averaging about 6.25.

Even though it is a heavy textured silty clay to clay, its excellent physical structure provides for rapid movement of air and water through this soil layer. Yet in it can be stored large quantities of both water and plant nutrients.

B_2 Horizon, 30 to 40 inches—Physically this horizon is practically the same as the B_1. It is slightly less acid and the structure is not so well defined.

C Horizon, 40 inches to bedrock—Hagerstown soil from the 40-inch depth to bedrock is a brown, yellowish brown or reddish brown, silty clay to clay that possesses sufficient structure aggregation to allow excellent circulation of air and water.

The internal drainage of the Hagerstown soil is excellent and there are no layers or horizons in it that restrict rapid movement of air or water. The entire soil from surface to bedrock provides an excellent medium for plant roots. Water that percolates downward enters the edges of massive limestone formations and continues downward to underground streams that finally emerge as springs that give rise to streams that flow from the limestone valleys.

Hagerstown is one of the most fertile and productive, upland, residual soils in Pennsylvania. Very little of it has been allowed to remain under forest cover. When cleared and plowed, the rich deposits of organic matter and soil humus in the A_0 and A_1 horizons are mixed with the A_2 horizon. As time went on, the organic materials gradually decayed and disappeared from the surface soil. When this survey was made, the plowed fields appeared grayish brown, for the original rich, dark brown color of the surface soil was gone. In many places erosion had allowed the subsoil to be exposed or mixed with the surface soil as the plow brought up more and more of the reddish brown clay.

Total Area and Location: The total area of Hagerstown soils in Fulton county is very small, probably not over 300 acres in all. The largest area is about 2 miles south of McConnellsburg.

Surface Drainage and Erosion: The internal drainage of this soil is rapid, and where it is under natural forest or dense grass cover there is rarely ever any runoff of surface waters. The water percolates downward and is carried off by underground streams except when the soil is frozen. In plowed and cultivated fields where the soil melts down and "puddles" or "pancakes" during hard rains, a condition develops in the surface that restricts the downward percolation of water which may allow both surface water runoff and erosion.

Natural Vegetation: The natural vegetation on the Hagerstown soils was hardwood forest containing white oak, red oak, walnut, cherry, hickory, and some white pine and maple.

Natural Fertility: Hagerstown soil as developed in this region is the most fertile and most productive, upland, residual soil found in south central Pennsylvania. The calcium and organic matter reserves of this soil were originally very high.

Current Use: Very little of this soil remains in forest. Wherever it can be plowed, it is used for crop production. Where it can't be plowed, because of too frequent exposure of limestones, it is used for bluegrass and clover pasture.

The major crops grown on this soil are corn, wheat, oats, clover, alfalfa, and possibly winter barley. Per acre yields for these crops under current management practices are: corn 40 to 60 bushels of shelled grain; wheat, 15 to 35 bushels; oats, 35 to 50 bushels; clover, 1 to 2 tons; and alfalfa, 2 to 2.5 tons.

Future Use Possibilities and Limitations: Use of this soil in the future will probably remain very much the same as it is at present. Future crop yields will depend greatly on soil management practices, such as the amount of lime and fertilizer applied, the control of erosion, and the return to the soil of as much organic matter in the form of manure or cover crops plowed under as possible.

Fig. 9.—Corn, as it is grown on Hagerstown soil.

The Frankstown Soil Series *

Origin of Soil Material: The parent material of this soil is residual in origin and was derived by chemical decomposition of impure limestones that contained appreciable quantities of sand and chert. These materials appear in sufficient quantity to impart to the soil a cherty, gritty, or sandy feeling.

Topography: Frankstown soil occurs on rolling to somewhat hilly relief, with land slopes ranging from 5 to 25 per cent. In Fulton county most areas of this soil have slopes of less than 10 per cent, and it occupies areas in the limestone valleys where elevation ranges from 750 to 1000 feet above sea level.

Regional Development and Profile Type: This is a medium deep, grayish brown, forest soil having a well developed A-B-C profile.

Description: It is a well drained, medium deep, medium acid, upland residual soil developed from soil material derived from sandy and cherty limestones. The depth of the soil varies from only a few inches on stony, steep sites to 5 or 6 feet on the more level areas, the average depth ranging between 3 and 4 feet.

A general description of this soil by horizons as found under natural forest cover is:

A_{00} Litter layer—The natural forest litter is composed mainly of leaves from red and white oaks. The thickness of leaf litter ranges from ½ to ¾ inch after settlement by the weight of snowfall.

A_0 Humus layer, 0 to ½ inch—a loose, mellow dark grayish brown, medium acid, humus material comprises the top layer of Frankstown soil. It possesses a loose spongy fine crumb to slightly platy structure.

A_1 Horizon, ½ to 2 inches—This horizon is a dark grayish brown silt loam to loam having only a very faint development of structure. There is a rather sharp boundary between the A_0 and A_1 horizons, the mineral material in this layer being heavily stained with dark brown to nearly black humus. The reaction of this horizon is medium acid, pH 6.0 to 6.5, which is more acid than the same horizon in the Hagerstown series.

A_2 Horizon, 2 to 12 inches—This horizon is a light grayish brown to brownish yellow or cream colored structureless loam to silt loam which if pulverized when dry has a floury feeling. Below 6 inches the soil is yellow in color for there is practically no

* The Frankstown Soil Series name was first used as a series name in the Bedford County, Pennsylvania, Soil Survey in 1913. The name was taken from the town named Frankstown.

organic matter or soil humus in this soil below the 6-inch depth. This is the most acid horizon. The pH reaction ranges from 5.0 to 5.5.

A_3 Horizon, 12 to 15 inches—This is the transition zone between the A_2 and B horizon. It differs from the A_2 horizon only in color and texture. The yellow color of this horizon is blushed or tinted with sufficient red iron oxide to give the soil a pinkish yellow or pinkish brown color. The texture of the soil is a silt loam which gradually changes to a clay loam at the 15-inch depth. Acidity ranges between pH 5.5 and 6.0.

B Horizon, 15 to 30 inches—A pinkish yellow to brownish yellow, and in some places yellowish brown, silty clay in which is developed a coarse granular or soft irregular nut structure comprises this horizon. The soil material is not as compact or plastic as the heavier clays of the Hagerstown soils.

C Horizon, 30 to 50 inches or bedrock—A yellowish brown to dull, drab silty clay having very little structure extends to bedrock. The soil of this layer is sticky and plastic when wet. The movement of air and water into and through this soil is rapid because internal drainage conditions are from good to excellent.

Pieces of shale-like residues and hard flinty chert fragments impart to this soil varying degrees of chertiness or shalyness that is often not appreciated by farmers who cultivate or mow over it.

Some areas of this soil, when located near and below areas of Dekalb soils, contain sufficient quantities of sand in both the surface and subsoil to give to the soil a sandy texture.

On the steeper slopes where this soil has been cleared and used for the production of cultivated crops, the surface soil gradually is being diluted with clay from the B-horizon. Where erosion has been aggressive, much of the original surface soil is gone.

Total Area and Location: The total area of Frankstown soil in Fulton county is approximately 4,000 acres, and most of it is in the valley south of McConnellsburg. This valley begins in the vicinity of Webster's Mills and continues northeast past McConnellsburg toward Knobsville where it terminates.

Surface Drainage: The surface and internal drainage of this soil is good. On the steeper slopes where the soil is exposed by plowing and cultivation, runoff may be sufficiently rapid to cause appreciable erosion, and on some of the steeper slopes nearly all of the surface soil is gone.

Natural Vegetation: The natural forest, as found on this soil was mainly hardwoods containing red oak, chestnut oak,

maple, white pine, some hickory, wild cherry, and other species commonly found in association with these trees.

Natural Fertility: The natural fertility of the Frankstown soil is below that of the Hagerstown series mainly because it contains more inert sand and chert. This soil is medium acid, having a natural deficiency of calcium. The same is also true for phosphorus and possibly potassium.

Where it has been cultivated for many years, the organic matter or humus reserves may be greatly reduced. This causes soils of cultivated fields to appear more gray, yellow, or brown in color than those under forest or grass cover.

Current Use: Very little of this soil is in forest and that which remains is in farm woodlots.

Cleared areas, wherever the soil is deep enough, are used for the production of corn, small grain, and hay. Hay crops are mainly red clover and timothy or red clover alone. Alfalfa has been grown with success on this soil where it has been treated with lime and phosphate fertilizer.

Soil depth, together with kind and quantity of lime and fertilizer applied, determine crop yields, but wherever the soil is 2½ feet deep or deeper the current yields per acre are: corn, 35 to 50 bushels; wheat, 15 to 25 bushels; clover and timothy or clover hay, 1¼ to 2 tons; and alfalfa, 2 to 2½ tons.

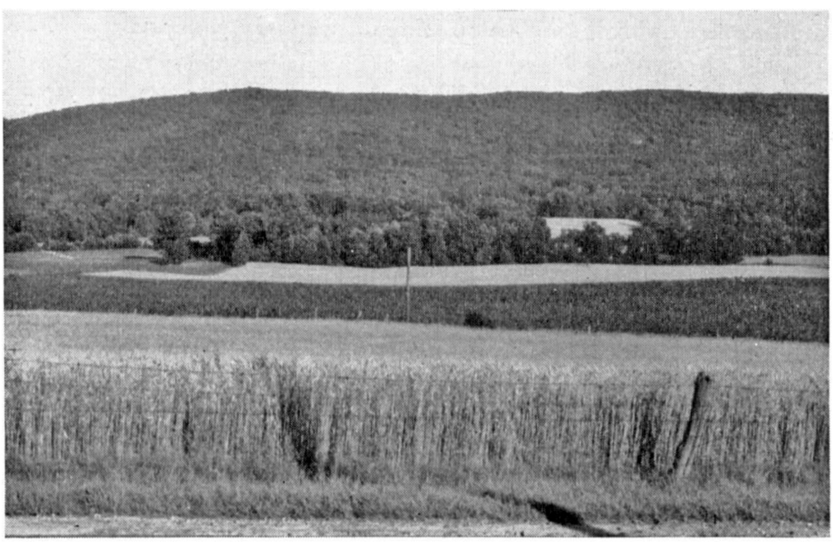

Fig. 10.—Oats, as grown on Frankstown soil in Fulton county.

Future Use Possibilities and Limitations: This soil if protected from erosion and managed carefully will be valuable crop land for many generations. However, farmers always will be confronted with the problem of maintaining or improving its fertility by applications of lime and fertilizers, and by the return to cultivated areas of as much organic matter as possible. It is a soil on which the farmer can well afford to invest lime and fertilizers for it will hold much of the material in readiness for plant use. Rotations should include as many grass and legume crops as possible for they protect the soil from erosion and aid greatly in conserving its fertility. Where used for pasture it should receive both lime and fertilizer.

The Elliber Soil Series

Origin of Soil Material: Elliber soil was developed from residual materials which have accumulated as a result of the chemical decomposition of very cherty limestones. It contains large quantities of angular chert which farmers often call "flint." In some sections of the country, especially in Virginia, this soil is called "skin-foot land."

Regional Development and Profile Type: This is a grayish-brown, forest soil of middle age maturity, with an A-B-C type profile.

Description: It is a deep, well drained, acid, residual soil derived from cherty limestones.

As found under natural forest cover Elliber soil may be described as follows:

A_{00} Litter layer—The forest litter consists mainly of leaf material from mixed stands of oak, chestnut, and pitch pine trees.

A_0 Humus layer, 0 to ¾ inch—This strongly acid, very dark brown to nearly black, peaty, humus layer tends to form a loose mat over the mineral soil. It is strongly acid, pH 5.0 to 5.25.

A_1 Horizon, 1 to 3 inches—The dark gray-brown, surface, mineral soil has had enough organic material intermixed by insect activity to give it a dark brown to blackish brown color. The soil minerals in this horizon are thoroughly leached by the organic acids which have their origin in the A_0 humus layer and percolate down through the soil. This layer is strongly acid, pH 4.75 to 5.00, and very cherty. The amount of angular chert varies but may be as much as 50 per cent of the soil mass, and some of the chert fragments may be as much as 3 inches in thickness.

A_2 Horizon, 3 to 12 inches—This is a very acid and cherty, grayish yellow to cream colored, gritty loam. It is the most acid horizon in this soil. The pH ranges from 4.75 to 5.00, and at this level the soil contains little organic matter. The soil is loose and porous with little or no structure development, and water moves downward through it rapidly.

A_3 Horizon, 12 to 15 inches—In this transition zone between the A and B horizons, the gritty and cherty soil material gradually changes to brownish yellow or becomes heavier and is a heavy silt loam at 15 inches. The acidity reaction ranges between pH 5.0 and 5.25.

B Horizon, 15 to 30 inches—A change in color from brownish yellow to yellowish brown, brown, or reddish brown as depth increases indicates less leaching and less acidity. In this horizon there are numerous blackish streaks or splotches of iron and manganese oxides. In texture, this soil is a gritty, silty clay. It is aggregated sufficiently to provide a mildly developed coarse, granular to small nut structure. Soil drainage is very good. The acidity reaction ranges between pH 5.25 and 5.50.

C Horizon, 30 to 50 inches—There is no definite boundary between the B and C horizons because there is no great change except the soil material of the C horizon contains less clay and is more brown in color. The acidity reaction of the C horizon ranges between pH 5.50 and 6.0. The total depth to bedrock is not well known but for most places it exceeds 4 feet except on steep slopes where erosion has been removing the soil about as fast as it is formed.

Where this soil has been cleared and used for crop production, the color of the surface soil is a brownish gray or gray. After rains, the surface presents a very cherty appearance; in extreme cases it may be nearly covered with coarse angular chert fragments. This chert material is very destructive to the cutting edges of plow shares, cultivator shovels, and mower sickles.

Topography: This soil occupies the tops and sides of long narrow hills or ridges where the land slope varies from nearly level to steep.

Total Area and Location: The total area of this soil in Fulton county is not more than 400 acres, and practically all of it is found on Stillwell ridge near Warfordsburg.

Surface Drainage and Erosion: Surface runoff under natural forest cover is practically zero, because the soil is very open and porous and rain enters the soil as fast as it falls. Where this soil has been cleared and is now being plowed or cultivated, rapid

surface runoff may occur following heavy rains. This will, of course, cause both sheet and gulley erosion, and a number of areas were severely eroded when this survey was made.

Natural Vegetation: Originally the forest cover was mainly oak, chestnut, chestnut oak, and pitch pine trees with some mountain laurel, huckleberry, and blueberry undergrowth.

Natural Fertility: The natural fertility of this soil, even though it is developed from materials derived from limestone, is very low. The soil is strongly acid throughout, pH 5.0 or less. Naturally it is deficient in calcium (lime), phosphorus, potassium, and probably other nutrient elements. With the organic matter content of this soil low, it is likewise deficient in organic nitrogen.

Current Use: More than half of this soil remains in forest. Much of that portion which is cleared is devoted to pasture, and only the less cherty or more level areas are used for the production of crops.

With chert interfering with plowing, tillage, and the mowing of hay, the use of this soil is mainly limited to pasture and corn production. Some areas have been planted to orchards.

Most of the pasture areas are of poor quality because of low soil fertility. Corn yields are in the 20 to 30 bushel-per-acre class. Fruit yields might be satisfactory if the orchards were properly cared for, but most of the fruit trees found on this soil are in poor condition because they have received little or no care in so far as spraying, pruning, or fertilizing are concerned.

Future Use Possibilities and Limitations. The chert content of this soil discourages cultivation, therefore the best future use for it no doubt will be pasture. However, if pasture grasses are to produce maximum growth, they must receive liberal applications of both lime and complete fertilizer. Orchard fruits may be grown on this soil but success can only be obtained where the soil is limed and fertilized.

Sub-Group B. Colluvial Soils of the Limestone Valley Areas.—Geologic time together with the downward creep of soil from the steep mountains has given rise to extensive deposits of transported soil out over the outer edges of the main valleys. This is especially true for the limestone valleys where extensive deposits of transported soil from the mountain areas now overlie residual soil derived from limestones or shales. These deposits frequently are very deep, and they usually are gravelly and may be stony. Where the subsoil drainage is good, as it is over limestone, a well drained soil is developed that has been included un-

der the Murrill series. Where the underground drainage is not good, because of underlying shale, an imperfectly drained soil is developed that has been included under the Buchanan series. The transported colluvial material for these two soils is the same, the major differences being in their subsoils.

The Murrill Soil Series

Genetic Origin of Soil Material: This soil was developed from the combined accumulation of both residual and colluvial soil materials both of which overlie massive beds of limestones. The subsoil material, even though it is deeply covered in places, is residual silt and clay derived from limestones. The surface mantle has been transported from residual soils derived from the acid sandstones and shales of the adjacent and higher mountain areas.

Topography and Physiography: The Murrill soils occupy the edges of the smooth to rolling limestone valleys where the surface of the land is frequently wavy because of "sinks" or "depressions" resulting from the uneven decay of the underlying limestones. The Murrill soils in Fulton county occupy elevations that range between 700 and 1,000 feet above sea level.

Regional Development and Profile Type: The Murrill soil is a light brown to gray-brown, forest soil having an immature A-B-C profile.

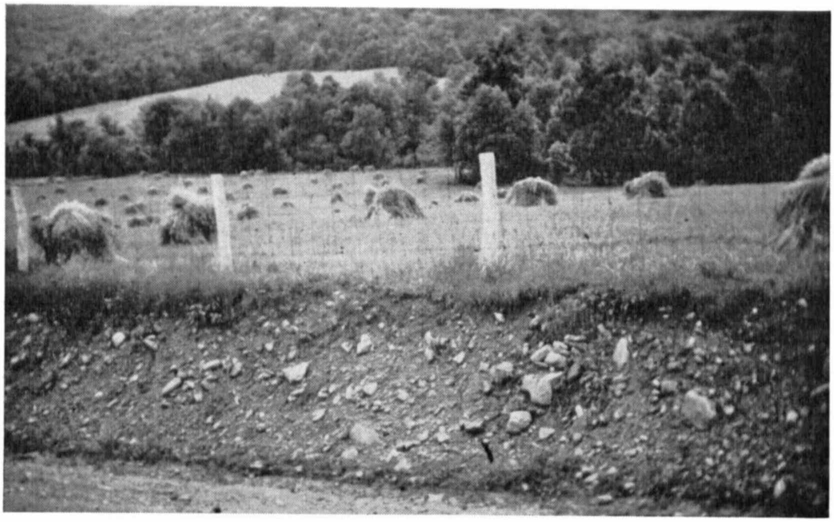

Fig. 11.—Murrill soil in vertical cross-section. This is a very deep soil which contains varying quantities of angular stone fragments. This soil overlies massive beds of limestone and is one of the best in the county.

Description: It is a deep, well drained, acid, colluvial soil, that usually contains gravel or cobblestones throughout its profile.

Profile description of soil as found under natural forest cover:

A_{00} Litter layer—The soil is covered with a mixed forest litter composed of oak, maple, and white pine leaf materials.

A_0 Humus layer, 0 to 1 inch—This is a very dark brown, medium spongy, and medium to strongly acid humus, having a soft, crumblike structure.

A_1 Horizon, 1 to 3 inches—The surface mineral soil is stained and coated with dark brown humus that gives this horizon a dark brown to dark grayish brown color. The soil has a loose mellow loam to sandy loam texture. It is acid in reaction, pH 5.24 to 5.50, and it possesses a mildly developed fine crumb structure.

A_2 Horizon, 3 to 12 inches—Brownish yellow to buff brown, acid, loam to sandy loam soil comprises this horizon. It possesses looseness but little if any structural aggregation, and normally it does not contain much organic matter. It is the most acid horizon of this soil, the pH ranging from 5.0 to 5.25.

A_3 Horizon, 12 to 15 inches—This is the transition layer between the A and B horizons where the brownish yellow color of the A horizon gradually changes to the yellowish brown color of the B horizon. The clay content of the soil material of this layer gradually increases with additional soil depth.

B Horizon, 15 to 35 inches—In this imperfectly developed B horizon, clays and colloids removed from the A horizon have accumulated. The soil material in this horizon is a sandy or gritty yellowish brown to brown, or for the exceptionally well drained areas even reddish brown, silty clay loam which has mildly developed, irregularly shaped, small nut structure. Blackish brown splotches or streaks of iron oxide stain are sufficiently numerous to be noticeable throughout the B horizon. The reaction of this horizon is acid, pH 5.25 and 5.50.

C Horizon, 35 to 60 inches or deeper—The color, texture, and structure of this horizon varies greatly depending on soil drainage and the origin of the material. For the better drained areas, the soil is usually a brown to reddish brown, silty clay. For the depression areas or where the soil is deep, the color is usually yellowish brown and the texture may be sandy, silty clay. The reaction of this horizon ranges between pH 5.5 and pH 6.25, but where limestones are close to the surface, this horizon may be only medium acid pH 6.25 to 6.5.

Most of this soil has been cleared and devoted to agricultural crops. Where plowed, the surface soil when wet is dark grayish brown in color; when it dries it is a light grayish brown.

There is but little surface erosion, therefore, the original surface soil still remains over most areas of this soil.

Total Area and Location: There are approximately 4,000 acres of this soil in Fulton county. Practically all of it is located along the east edge of the limestone valley locally called "the Cove" in which the towns of McConnellsburg and Websters Mills are located.

Surface Drainage and Erosion: The surface drainage for all Murrill soils ranges from good to excellent. Erosion over most areas of this soil has been of little importance, for the soil is open and porous enough to absorb the normal rainfall for this area.

Natural Vegetation: The natural forest as found on this soil contained species of red oak, scarlet oak, white oak, white pine, maple, and some walnut, hickory and wild cherry.

Natural Fertility: This soil, because of its origin, has a surface fertility that is naturally low but a subsoil fertility much above that of the soils of the shale hills or mountain areas. It has been the best forest soil in the region for on it grew magnificent stands of large and valuable timber. Under natural conditions this soil is acid, pH 5.0 to 5.5. It is deficient in calcium phosphorus, potassium, and possibly other important plant nutrients except for the cultivated land where these materials have been added. Physically, the Murrill series includes the best soils in the county.

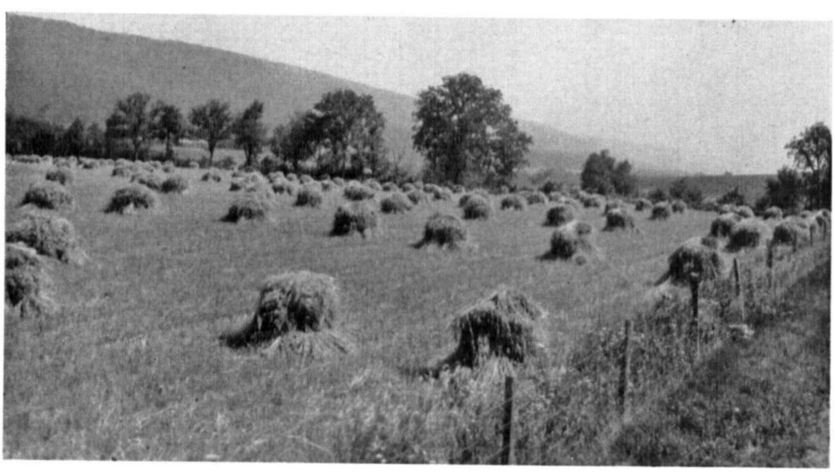

Fig. 12.—Wheat harvest on Murrill soil in Fulton county.

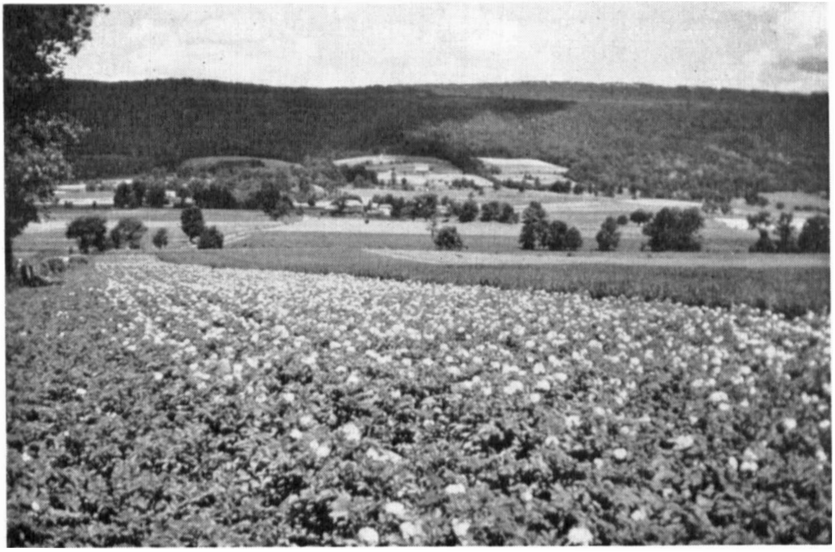

Fig. 13.—Crops as they may be grown on Murrill soil. Potatoes in the foreground with oats and wheat on the right. It is also an excellent soil for corn.

Current Use: Practically all areas of the Murrill soils have been cleared of forest and are now used for production of general farm crops: corn, small grain, potatoes, hay (clover, clover and timothy, and some alfalfa) and occasionally special crops of which tomatoes and sweet corn are of greatest importance.

Per acre crop yields under current farm practices are: corn, 40 to 90 bushels of shelled grain; wheat, 20 to 40 bushels; oats, 35 to 60 bushels; clover or clover and timothy hay, 1½ to 2½ tons; alfalfa, 2 to 3½ tons; and potatoes, 250 to 300 bushels where the soil has received commercial fertilizers.

Future Use Possibilities and Limitations: The Murrill soils, because of their origin and excellent physical characteristics (texture, structure, porosity, etc.), have the most lasting and enduring possibilities of any of the limestone valley soils. Physically these soils are excellent and the main problem in their future use is in the maintenance or increase of their fertility by maintaining or increasing the organic matter content of the soil and continued addition of lime and fertilizer in the amounts needed by growing crops. The fertility of the Murril soils can be improved rapidly, and eventually it can be built up to where its productive capacity will equal or exceed the production limits of the climate of the area.

General farm crops will no doubt dominate the agriculture on this soil which has a great capacity to produce corn, potatoes,

alfalfa, and possibly orchard fruits and small fruits on sites that are free from cold air drainage or frost pockets.

The Buchanan Soil Series

Origin of Soil Material: Buchanan soil was developed from the combined accumulation of residual materials derived from shale over which there had been deposited colluvial material transported from residual soils derived from acid sandstones and shales of the higher mountain areas.

Topography and Physiography: This soil occupies smooth to sloping, shale valley areas near the bases of the higher mountains. The elevation of this soil is from 600 to 900 feet above sea level.

Regional Development and Profile Type: It is a grayish brown, imperfectly drained, acid, forest soil having an A-B-C profile.

Description: This is an imperfectly drained, acid, colluvial soil overlying massive shale formations.

Profile description of Buchanan soil as found under natural forest cover:

A_{00} Litter layer—The mixed forest leaf litter is from a hardwood forest of oak, beech, maple, and hickory trees.

A_0 Humus layer, 0 to ¾ inch—This dark brown to black, humus layer form a compact mat over the mineral soil. The reaction of the layer is acid, pH 4.75 to 5.25.

A_1 Horizon, ¾ to 3 inches—This layer is a very dark gray to dark grayish brown or yellowish brown, acid silt loam with a reaction range of pH 4.75 to 5.25. When moist but not wet, it has some development of a coarse crumb structure.

A_2 Horizon, 3 to 12 inches—A yellow to brownish yellow heavy silt loam to silty clay loam having no structure comprises this horizon. Its reaction is acid, pH 4.5 to 5.0. Drainage and air circulation is fair but may be imperfect during wet seasons.

A_3 Horizon, 12 to 15 inches—This is the transition zone between the A and B horizons. The soil texture is silty clay loam.

B Horizon, 15 to 30 inches—Yellow and gray mottled, heavy, silty clay that is plastic when wet and hard when dry characterizes this layer. Drainage is imperfect to poor and air circulation is poor. The soil reaction is acid, pH 5.0 to 5.25.

C Horizon, 30 to 50 inches—A rusty brown, blue, gray, yellow, and black mottled, heavy, plastic, silty clay which has poor drainage during the winter and spring months is found at this depth. When wet this horizon is very sticky and plastic; when

dry it becomes tough and hard. The lower subsoil overlies shale beds that restrict or prohibit the development of good soil drainage.

Areas of this soil where plowed and allowed to dry have a brownish yellow to brownish gray or gray surface color.

Total Area and Location: The total area of Buchanan soil in Fulton county is approximately 200 acres, and nearly all of this is located in the narrow "Cove" near Knobsville.

Surface Drainage and Erosion: Surface drainage is fair but in winter and spring surface water from higher levels flows down over this soil causing it to remain wet until late spring or until after snow has finished melting in the mountains. There is little or no erosion on this soil. The major problem is the removal of excess water. There is also an underground subsurface flow of seepage water from the higher to lower levels which retards soil drying in early spring.

Natural Vegetation: The natural hardwood forest, as found on this soil, contained species of oak, beech, maple, and hickory with some mountain laurel and rhododendron as undergrowth.

Natural Fertility: The natural fertility of this series is low, because of high acidity, excessive leaching, and low reserves of calcium, phosphorus, and potash.

Current Use: Most of the Buchanan soil as mapped in Fulton county is used for hay, pasture, or corn production. The hay crops are mainly alsike clover and timothy. This soil is a little too wet for best success with red clover. The pasture grasses that tolerate this soil are white clover, alsike clover, bluegrass, and red top. Corn when grown on this soil matures late because of being located in narrow valleys that fill with cold air at night even in summer. Corn yields are estimated to be from 25 to 50 bushels of shelled grain per acre depending on the season.

Future Use Possibilities and Limitations: Drainage of this soil could be improved by diversion ditches installed to prevent water from the higher mountain areas from flowing over or through it after wet periods. If properly drained, limed, and fertilized, this soil could be made to produce excellent growths of valuable pasture grasses and clover hay crops.

Soil Group III. Medium Deep to Shallow Upland Soils Developed From Shale Materials

In Fulton county two important shale formations are exposed which when weathered give rise to medium deep, upland residual soils. One of these, the Cayuga formation is made up of

alternate strata of yellow and brown shale. The yellow strata contains considerable lime but the brown strata rarely ever contains sufficient lime to be detected by the usual field test, the application of dilute acid. If there is no bubbling or effervescence when the acid flows over the material tested, it is assumed there is no lime in it. From this combination of shales two soils have been developed, the Edom and Carbo* series. It is practically impossible to map these soils separately, therefore, in this survey report, the two have been grouped and called Mattawana soils. From other formations which include the Catskill and Mauch Chunk red shales, a medium deep to shallow reddish brown upland soil has been developed, called Calvin. The name of this series came from the community of Calvin in Trough creek valley of Huntington county where extensive areas of this same soil were mapped during the Huntington county soil survey.

The Mattawana Soil Series
(A Combination of Edom and Carbo * Series)

Genetic Origin of Soil Material: A residual material derived through the physical disintegration and chemical decomposition of interstratified brown and yellow shales form this soil. The brown shales are non-calcareous but the yellow shales contain appreciable quantities of lime carbonates.

Topography and Physiography: Mattawana soils are found on rolling shale hills with land slopes varying from nearly level hill tops or bench lands to very steep inclines near streams. These soils occupy shale valleys where stream dissection and land erosion is very aggressive.

Regional Development and Profile Type: This is a brown and yellowish brown forest soil having an A-(B)-C profile.

Soil Description: It is a medium deep, upland, residual soil complex including parent soil materials derived from non-calcareous brown shales and calcareous yellow shales.

This soil where found under forest areas may be described as follows:

A_{00} Litter layer—The forest litter is composed of mixed hardwood leaves from oak, maple, hickory, walnut, white pine, etc.

A_0 Humus layer, 0 to ½ inch—The surface layer is a thin, loose, mellow to slightly granular or soft spongy, brown to dark brown humus that is medium acid in reaction.

* Correlation Corrections — Change Carbo to Calvin Series.

A_1 Horizon, ½ to 3 inches—A layer of brown to yellowish brown soft mellow loam to silt loam soil material having a fine crumb structure forms the second horizon. The reaction of this layer ranges from pH 6.75 to 6.0. Air and water circulation through this layer is rapid.

A_2 Horizon, 3 to 10 inches—This horizon is light brown to brownish yellow silt loam having but little structure aggregation. Reaction varies from pH 5.75 to 6.75 depending on content of calcium in underlying shales.

A_3 Horizon, 10 to 12 inches—In the transition zone between the A_2 and B horizons, the color of this soil becomes darker, the reaction is less acid, the aggregation is more pronounced, and a coarse granular to fine nut structure is developed.

B Horizon, 12 to 24 inches—The soil of this horizon is a yellowish brown, brown, or pinkish brown, silty clay to clay that has a coarse granular to fine nut structure and a rather high degree of plasticity and stickiness when wet. It becomes rather hard when dry. The colloidal clay appears to be dispersed when wet and restricts rapid movement of air and water which in part is responsible for the rather high rate of erosion commonly found over areas of this soil.

C Horizon, 24 to 36 inches—A yellow or brown, shaly, silty clay is found overlying the parent shale. The yellow material is in most places derived from the yellow calcareous shale, and the brown colored soil is usually found over the brown non-calcareous shale. The shale content of the C horizon varies greatly and in many places more than half of the material in the C horizon is weathered shale. The yellow material is usually nearly neutral and may even be alkaline. The brown material is usually medium acid, pH 6.0 to 6.5.

Total depth to weathered shale varies from 30 to 60 inches with the shallower soil occurring on the steeper slopes.

The physical and chemical characteristics of this soil favor erosion wherever it is plowed. Therefore, as one would expect, all areas of Mattawana soils that have been cultivated for a number of years have lost valuable surface soil because of erosion.

Freshly plowed fields are streaked or striped because the soil is developed from shales of two different colors, one streak being brown or reddish brown and the other yellow, yellowish brown, or grayish brown. Where clover has been seeded on unlimed areas the best stands are obtained on the yellow or yellowish brown areas because of the calcium that the soil inherited from the yellow shales. In contrast poor stands of clover are common over the

more acid brown or reddish brown areas where the soil is derived from the non-calcareous shales.

Total Area and Location: Taken together the two areas of Mattawana soil in Fulton county do not exceed 3,000 acres. The largest area is in Pigeon Cove near Warfordsburg. The other is in the vicinity of Fort Littleton. Neither is really typical of the truly developed Mattawana soil as found in Huntington, Mifflin, Perry, and Juniata counties because the areas are narrow and they are influenced greatly by surrounding areas of other soils.

Near Knobsville there is a small area of imperfectly developed Berks (Bks.) soil that was included with the Mattawana series. In detailed surveys this minor separation would be preserved.

Surface Drainage and Erosion: Both surface and internal drainage of Mattawana soil varies from good to excessive. Surface runoff for most areas is rapid and erosive, and in many unprotected or cultivated areas the fertile topsoil has been severely thinned by both sheet and gulley erosion. The problem of erosion on this soil is serious and unless properly controlled it will, within a few years, reduce the steeper slopes to a state of land abandonment as far as crop production is concerned.

Natural Vegetation: The original forest cover was mainly mixed hardwoods with occasional stands of white and pitch pine. Little to no undergrowth of laurel or huckleberries was found growing in the forests on this soil.

Natural Fertility: The natural fertility of the Mattawana soils is intermediate to above average for the region because of the calcium reserves of the underlying shales. The first limitation of plant growth probably is moisture where the soil is shallow or is reduced to a shallow depth by erosion.

Current Use: Practically all of this soil is free of stone; therefore, it has been cleared of forest and plowed for agricultural use. Approximately half of the cleared areas are used for the production of cultivated crops, mainly small grains, corn, and hay. This soil, because of its physical and chemical characteristics, erodes badly, and the soil in many places has been thinned to where it does not absorb or retain sufficient moisture for crops, like corn, that mature in late summer or early fall. At present, the acreage of corn grown on this soil is decreasing each year because of erosion. More small grain, hay, or pasture should be grown, because such crops mature early or before the soil moisture supply becomes too low for good plant growth.

Corn yields of the more level and deeper areas of this soil range from 25 to 40 bushels of shelled grain per acre, but on the

shallow or steeper areas yields are often as low as 20 bushels per acre. Hay yields for clover and timothy mixed range from ½ to 1 ton per acre, with the greater yields obtained on the deeper and more level land.

Future Use Possibilities and Limitations: As previously indicated the nutrient reserves of this soil are not especially low, but its soil moisture storage capacity is limited, especially where it is less than 2 feet deep. Its future value for agriculture depends much upon erosion control. This soil possesses considerable value if used wisely, since it can be developed into comparatively good pasture and hay land. The more level and deeper areas can be devoted to corn but corn production on steep slopes should be discouraged because of the extravagant erosion that occurs when the soil is cultivated.

The Calvin Soil Series *

Genetic Origin of Soil Material: The Calvin series is a residual upland soil derived from medium acid, red and reddish brown, silty shales that often contain very thin laminations of green shale. Geologically these shales are the Catskill and Mauch Chunk formation.

Topography and Physiography: This soil is developed over rolling to steep shale hills that occupy the higher valleys of the Appalachian Ridge and Valley section of south-central Pennsylvania, and western Maryland.

Regional Development and Profile Type: This is a brown forest soil generally of the A-C type profile, but which also includes the A-B-C profile on the more level areas where soil development processes have had sufficient time to develop a deeper and more mature profile. The A-B-C type profile has recently been given the series name of Ungers.

Soil Description: A generalized description for the Calvin-Ungers complex is given below. This description was taken from a profile of this soil as found in a rather level area of natural forest.

A_{00} Litter layer—The forest litter came from hardwoods that were dominantly red and scarlet oaks.

A_0 Humus layer, 0 to ¾ inches—The humus layer that covers the surface soil is loose, spongy, and dark brown in color. It is medium acid in reaction, pH 5.75 to 6.00.

* Recently the Calvin Series has been subdivided. For future mapping the Calvin Series shall be limited to the A-C type of soil profile and the Ungers Series will include all Calvin soils that possess the A-B-C type of soil profile. The description of the Calvin Series as given in this report is in reality a description that should be applied to the newly established Ungers Series.

Fig. 14.—Cross-section illustrating the approximate average depth of Calvin soil. Where cleared and cultivated it varies from 15 to 30 inches.

A_1 Horizon, $\frac{3}{4}$ to $2\frac{1}{2}$ inches—Beneath the humus there is a dark brown, loose, mellow loam that possesses a soft fine crumb structure. The soil minerals are thickly coated with organic stains. The reaction of this horizon is acid, pH 5.50 to 5.75.

A_2 Horizon, $2\frac{1}{2}$ to 12 inches—The brown, silt loam soil of this layer is loose, open, and porous with little aggregation or compaction. It is the most acid layer in the soil, the reaction being between 5.00 and 5.75.

A_3 Horizon, 12 to 15 inches—In the transition zone between the A and the mildly developed B horizon, the soil is a slightly reddish brown, silty clay loam that possesses very slight aggregation or a mild development of coarse granular structure.

B Horizon, 15 to 30 inches—Reddish brown, coarsely aggregated, silty clay loam prevails between 15 and 30 inches. This soil, even though it contains considerable clay, is not especially sticky or plastic when wet. Water moves through this horizon freely and it possesses good drainage. The moisture storage and water holding capacity is very good. Reaction ranges between pH 5.7 and 6.5.

C Horizon, 30 to 40 inches—This horizon contains reddish brown, silty clay loam parent soil material as it has been derived from brownish red, acid, silty shales. This horizon contains a large amount of weathered shale fragments. Small pieces of shale may be found in all horizons but the greatest concentration and largest pieces of shale are found in the C horizon. The reaction of the C horizon is medium acid, pH 6.00 to 6.5.

Nearly all of the more level areas of Calvin soil have been cleared of forest and are used for crop production. All of those areas that have been plowed and cultivated have lost most of the original organic matter. As the organic matter of the surface soil decreased, the color became more gray, and where erosion has been aggressive, the original surface silt loam has become shallower and more red as the reddish colored subsoil has been mixed with the remaining surface soil.

At the time of this survey, nearly all cultivated fields of Calvin soil were reddish brown in color and the surface soil contained appreciable quantities of broken pieces of weathered shale. Where erosion had been severe, the amount of weathered shale in the remaining surface soil was found to be as much as 30 per cent of the soil mass. For many areas the total soil depth had been reduced by erosion from the original 30 to 40 inches to as little as 10 inches on steep slopes. Soil depth in most cultivated fields now ranges between 15 and 25 inches. On steep slopes where erosion has been rapid and aggressive, nearly all of the original soil is gone.

Total Area and Location: The total area of Calvin soil in Fulton county is approximately 50,000 acres. It occupies large and continuous areas which are not difficult to locate on the soil map. Large areas of this soil extend into Bedford and Huntington counties.

Surface Drainage and Erosion: The surface drainage of Calvin soil varies from rapid to excessive. Water runoff is erosive for the soil is developed over a rolling to hilly relief where over three-fourths of the slopes are steeper than 15 per cent. Wherever the soil is occupied by natural forests, the leaf litter and trees protect it from beating rains and erosion, but on cultivated fields heavy rains pack the surface soil quickly, a condition which promotes rapid runoff thereby causing serious erosion. Many areas have lost more than half of their original surface soil, and approximately one-fourth of the cleared or plowed land has lost practically all of the surface soil. Some areas on steep hillsides have been eroded so badly that they have been allowed to revert to abandoned "old fields" that are now supporting nothing more than a poor growth of poverty grass and Virginia scrub pine.

Natural Vegetation: Hardwoods dominated the natural vegetation of Calvin soil, red oak and scarlet oak being most abundant. Some chestnut and white pine are found in the older and better preserved farm wood lots. There is little to no undergrowth of either mountain laurel, huckleberry, or blueberry in

forested areas, and it is doubtful if there ever was much growth of these plants in the original forests.

Natural Fertility: The natural fertility of the Calvin soil is higher than that of the Gilpin and Amberson series but lower than that of the Mattawana soils. There is no lime in the parent shales from which the Calvin soil is derived, therefore, it is only natural that it is deficient in calcium. The Calvin soil, because of its physical and chemical characteristics, responds quickly to lime and fertilizer. Absorption and movement of water through Calvin soils is rapid. Wherever the soil is deep it has the capacity to absorb and store adequate moisture reserves for most crops.

Current Use: Approximately one-fifth of the area occupied by Calvin soil remains in natural forest with most of the timber on the steeper slopes. Of that portion that has been cleared, approximately one-third occupies land where the slope is less than 8 per cent, one-third where the slope ranges between 8 per cent and 15 per cent with erosion important, and one-third occupies slopes steeper than 15 per cent over which erosion is very aggressive and can be controlled only by keeping the soil occupied by permanent covers of hay crops, pasture grasses or forest.

The Calvin soils are primarily suited to the production of small grain, hay, and pasture, but at the present time most of the more level areas are used for corn.

Corn yields on the deeper and more level areas range from 35 to 50 bushels of shelled grain per acre with yields only about half this amount on the slopes that exceed 10 per cent. Wheat yields, where fertilized, range from 15 to 20 bushels per acre but may go to 25 or even 30 bushels in the more level areas where the fertility of the soil has been increased to a high level by applications of lime and fertilizer. Oat yields range from 20 to 35 bushels, occasionally going up to 40 bushels per acre where the soil is deep and has been fertilized. Clover yields vary from ½ to 1¼ tons per acre depending on soil depth, steepness of slope, amount of lime and fertilizer used, etc. A few farmers have been able to establish and produce alfalfa on the deeper areas of Calvin soils by applying liberal amounts of lime and phosphorus. In Bedford county on a farm 1 mile southwest of Stevens Chapel and 5 miles east of Clearfield, alfalfa was found to be growing successfully on Calvin soil where the farmer applied 1 ton of burned lime and 150 pounds of superphosphate per acre, but in most localities 2 tons of ground limestone and 400 pounds superphosphate per acre would give much better results.

The Calvin soil is not well adapted to the production of mid-summer pastures because it dries out rapidly in hot weather.

Future Use Possibilities and Limitations: Soil depth and soil moisture storage capacity together with soil erosion are the factors that limit the production capacity of this soil. Where the Calvin or Ungers soils occupy the more level areas and where they are still fairly deep and can be protected from erosion, there are opportuntiies for improving and increasing their productivity by applications of lime and fertilizer. Lime alone will not be enough. Phosphorus and potassium fertilizers also must be applied to balance the improvement made by liming the soil.

One of the greatest problems involved in the use of the Calvin soil for the production of crops is that of erosion control. Corn is one of the crops that requires cultivation and cultivation speeds up erosion. The future use of much of the Calvin soil should be built around more small grain, hay and grass crops, and the limiting of corn production to only those areas where the land slope is level enough to permit effective control of erosion.

Soil conserving crops should be grown on Calvin soil, and they should be of the kind or type that mature early for this soil has a tendency to dry out rapidly in mid-summer when temperatures become high and rainfall may be deficient.

Recently a number of farmers in the vicinity of Hustontown have found that peas can be grown successfully on Calvin soil. This soil, because of its excellent internal drainage, and loamy texture, has physical qualities that favor both the early planting and early maturity of this crop. Yields of potatoes, corn, and

Fig. 15.—Corn and oats on Calvin soil. The original forest in the background is nearly all red oak.

tomatoes, which mature in late July and August, may be greatly reduced by droughty conditions in the soil when rainfall becomes less than an inch per week.

Soil Group IV. Shallow Droughty Soils of the Shale Hills

In Fulton county extensive areas of acid, silty to sandy, arenaceous shales are exposed at very steep angles. Geologically these shales have been given the names:

1. Catskill-Chemung (complex) : When weathered, this complex of intra-bedded, gray and brown shales provides the parent materials for the Amberson soil series.

2. Hamilton, Chemung, and Portage Shales: These shales and their associated members range in color from olive drab to gray and dark gray, respectively. Any of these acid shales, when weathered, may provide the parent materials of the Gilpin (Ashby) or Rayne (Lashley) soil series. Extensive areas of these shales and soils have been mapped in other south-central Pennsylvania counties.

The Rayne* (Lashley) Soil Series

Genetic Origin of Soil Material: This is a residual upland "shale hill" soil derived from acid, olive drab, gray or dark gray, silty to sandy, Hamilton, Chemung and Portage shales.

Topography and Physiography: This soil series is found mainly on the more level ridge tops and in the saddles between ridges throughout the "shale hill" sections of south-central Pennsylvania, western Maryland, and the Appalachian ridge and valley section of Virginia and West Virginia.

Regional Development and Profile Type: It is a brownish-gray forest soil possessing an immature A-(B)-C profile. In total depth, it ranges from 2 to 4 feet, averaging about 3.

Description: A generalized profile description of this soil as developed and found under forest cover follows:

A_{00} Litter layer—The forest litter is mainly leaf material from a mixed oak-pine forest.

A_0 Humus layer, 0 to 1 inch—This layer is very dark brown to nearly black, tough, compact, strongly acid material, mainly of

* The Rayne series in older surveys was called Dekalb. The Rayne series has recently been further sub-divided. Now all Rayne soils as previously mapped east of the Allegheny plateau and Plateau front are to be classified as Lashley soils, leaving the original and true Rayne soils on the Allegheny plateau where they were first classified and mapped. The Lashley soil is not as deep or productive as the Rayne soil.

the "duff" humus type. There is a sharp boundary line between the A_0 and A_1 horizons, and the reaction of the humus is strongly acid, pH 5.0 to 5.3.

A_1 Horizon, 1 to 2 inches—Grayish-brown to light brown, loose, mellow silt loam to loam forms this horizon. It contains an appreciable quantity (0 to 15 per cent) of thin fragments of weathered shale. This horizon is strongly acid, pH 5.0 to 5.4.

A_2 Horizon, 2 to 10 inches—This layer is pale brownish-yellow to grayish yellow-brown loam to silt loam. It possesses a loose, mellow, single grain structure, and small pieces of weathered shale fragments are numerous. This horizon is very low in fertility, and is strongly acid, pH 4.8 to 5.2.

A_3 Horizon, 10 to 14 inches—In the transition zone between the A and B horizons, the soil color gradually changes to yellowish brown as depth increases.

B Horizon, 14 to 22 inches—The soil material of this horizon is a yellowish brown to brownish drab, heavy silt loam to silty clay loam having a weakly developed nut structure. It is open, porous, and strongly acid in reaction, pH 5.0 to 5.4. Small fragments of weathered shale are numerous.

C_1 Horizon, 22 to 34 inches—At this depth, the soil is a yellowish brown to drab, open, porous, shaly silt loam containing an abundance of weathered shale fragments. Its reaction is acid, pH 5.2 to 5.5.

Geological Material. Partly disintegrated, acid, gray to drab, arenaceous shales and some thick bedded, fine grained sandstones, comprise the parent rock materials. These shales are exposed at steep angles, and for most areas this soil lies on the upturned edges of these shales.

Approximately 90 per cent of the total area of Rayne soil has been cleared of forest and devoted to the production of farm crops. This soil where used for crops has a total depth of 2 to 4 feet which is sufficient to provide for reasonably good storage of soil moisture. Erosion is important but not serious because it occupies the smoother and more level ridge tops. Fertility is low, unless liberal amounts of lime and fertilizer have been applied. Plowed areas of Rayne soil appear light gray, mainly because it does not contain sufficient organic matter to darken its color. Where areas of this soil have been subjected to erosion, and the original surface soil has been washed away, it usually appears yellow or yellowish brown, depending largely on which horizon is exposed. The subsoil is predominantly yellowish-brown.

Total Area and Location: The total area of the Rayne (Lashley) soil in Fulton county is not more than 1,000 acres. It

occurs as small irregular areas on ridge tops. Most of these areas are too small to be accurately shown on a soil map of the scale used for this type of survey, but there are hundreds of such areas, included with the Gilpin (Ashby) soil as it was mapped in this survey.

Drainage and Erosion: Rayne (Lashley) soils have excessive surface drainage. Erosion is important and where the steepness of the slope exceeds 5 per cent it becomes serious. This soil, where located on steep slopes, will have to be protected from excessive erosion if future farmers are to have a soil suitable for crop production.

Natural Vegetation: Natural vegetation consists mainly of chestnut oak, red oak, scarlet oak, and pitch pine. In this forest are found some species of hickory, maple, white pine, gum and other species of trees commonly associated with an oak-pitch pine type of forest. In old fields which have been idle for a number of years, Virginia scrub pine comes in quickly. Poverty grass, golden rod, and brambles provide the main vegetative cover for "old fields" or abandoned farms located on this soil.

Natural Soil Fertility: The natural fertility of the Rayne (Lashley) soil is very low, mainly because of the kind of shale from which the soil was originally derived.

Current Use: Approximately 90 per cent of the total area of this soil has been cleared and used for farm crops. The main crops are corn, wheat, oats, hay (clover and timothy) and pasture. Crop yields are generally low, unless liberal amounts of lime and fertilizer have been applied. This soil improves quickly when lime and fertilizers are added in moderate amounts.

Crop yields per acre under current production practices range as follows: corn, 25 to 40 bushels of shelled grain; wheat, 12 to 18 bushels; oats, 20 to 30 bushels; clover-timothy hay, 3/4 to 1 1/4 tons; potatoes, 150 bushels if heavily fertilized (600 to 800 pounds of complete fertilizer per acre) ; and buckwheat, 8 to 15 bushels.

Future Use Possibilities and Limitations: Fertility and erosion control will determine the future usefulness of this soil. It responds quickly to lime and fertilizers, but likewise it loses its fertility rapidly through leaching.

It is naturally deficient in organic matter reserves; therefore, farmers should return as much organic material to this soil as possible in the form of manure or cover crops plowed under. The Rayne (Lashley) soil is the most productive upland soil in the Gilpin (Ashby) soil areas; therefore, it should be kept in as high a state of productivity as possible.

The Gilpin * (Ashby) Soil Series

Origin of Soil Material: The Gilpin (Ashby) series is an upland "shale hill" soil derived from gray, acid, silty shales. It overlies the upturned edges of massive arenaceous shale formations. Geologically, they are the Hamilton, Chemung, and Portage shales.

Topography and Physiography: The Gilpin soil is developed on hilly topography where the slopes range in steepness from zero to 60 per cent, with most areas occupying inclines ranging from 10 to 30 per cent.

Development: Geologic erosion and dissection has been so aggressive throughout the "shale hill" areas that the soil material was never allowed to remain in place long enough to develop into a deep soil having an A-B-C type profile. Therefore, the Gilpin (Ashby) soil is shallow, 30 inches or less, and its profile development is limited to the A-C type. The entire soil profile contains angular and sub-angular pieces of partially weathered shale fragments which are often referred to as "shanners."

Description: This shallow, acid, low fertiltiy soil is derived from acid, gray arenaceous shales. A profile description of this soil as found under forest cover follows:

A_{00} Litter layer—The forest litter is mainly from the oak-pitch pine type of cover.

A_0 Humus layer, 0 to 1 inch—A very dark brown to black, acid, peaty or "duff" type of humus mat lies like a rug, on the soil. The acidity is very strong, pH 4.8 to 5.3.

A_1 Horizon, 1 to 3 inches—This horizon is composed of a brownish gray to yellowish gray-brown, shaly loam in which small, sub-angular, shale fragments are numerous. This horizon is strongly acid, pH 4.9 to 5.2, and it possesses little or no structural aggregation.

A_2 Horizon, 3 to 10 inches—This leached horizon which is pale yellowish gray, is very acid, pH 4.8 to 5.5. Naturally it is very low in fertility. The texture ranges from shaly silt loam to loam, and the structure is of the single grain type; that is, the soil material possesses little or no aggregation.

A_3 Horizon, 10 to 13 inches—This is the transition layer between the A_2 and C horizons.

* The Gilpin series of south-central Pennsylvania has been recorrelated since this survey was made and in future surveys this soil will be known as the Ashby Series.

C_1 Horizon, 13 to 18 inches—This layer is a pale brownish yellow to grayish yellow-brown, loose, shaly silt loam which is strongly acid, pH 5.2 to 5.5.

C_2 Horizon, 18 to 30 inches—The soil of this horizon is pale yellowish brown, loose, shaly loam to silt loam having no structure. It is strongly acid, pH 5.5 to 5.7.

The entire C horizon contains angular shale fragments. The quantity of shale in the lower C horizon varies from 10 to 60 per cent.

Geological materials underlying this soil are the upturned edges of the Hamilton, Chemung, and Portage shale formations, all of which are acid, arenaceous shales. These materials are naturally deficient in many important mineral elements needed by plants and by animals that may eat the plants; hence, soils derived from these shales are low in agricultural value.

Fully half of the total area of the Gilpin (Ashby) soil has been cleared of forests and devoted to the production of crops. This soil, because of its position on steep slopes, its shallowness, looseness, siltiness, and general low fertility, when plowed and cultivated is subject to severe erosion when rainfall is heavy. With the removal of the forests and plowing of the soil, the organic matter reserves were rapidly depleted by both decay and erosion. At present most plowed fields of Gilpin soil are brownish gray in color except for the severely eroded areas which are brownish yellow because erosion has exposed the C horizon subsoil.

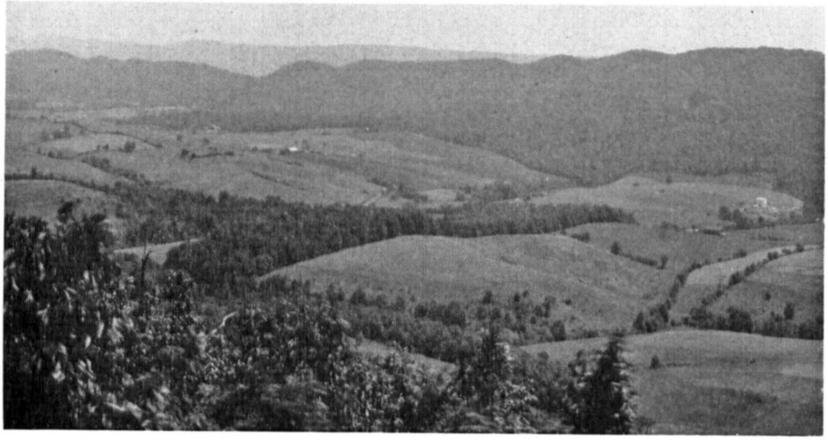

Fig. 16.—Typical topography of Gilpin soil. The mountain in the background is Little Scrub ridge. Photograph taken from observation tower at Summit, west of McConnellsburg on U. S. 30.

Throughout the surface and subsoil, quantities of angular, weathered shale fragments occur which impart a shaly condition, giving rise to the term shaly loam or shaly silt loam as used in defining texture.

Gilpin soil varies greatly in depth and content of shale materials. In the forest areas, depth varies from 15 to 36 inches and averages between 20 and 30 inches. Where the land has been cleared and plowed for a number of years, however, the depth may range from only a few inches to 2 feet but averages between plow depth (6 to 8 inches) and 18 to 20 inches, depending on steepness of slope, severity of erosion, past treatment, vegetation cover or protection, etc. In general, the quantity of shale fragments in plowed fields is much greater than in the same soil under forest cover because the fine soil material erodes away. The coarser shale fragments remain unless the erosion rate becomes excessive and both soil and shale materials are washed down the slope, as has happened already in too many places to form deep ugly gullies in cultivated fields.

Total Area and Location: This soil occupies approximately two-fifths of Fulton county, most of which makes up a broad, high valley area through the central part of the county (See Soil Map). Extensive areas of this soil have been found throughout the Appalachian Ridge and Valley section of south-central Pennsylvania, western Maryland, eastern West Virginia, and the northwestern part of Virginia. Everywhere this soil is shallow, erosive, and low in natural fertility.

Surface Drainage and Erosion: The surface drainage rate for this soil is excessive and erosive. Even though this soil is loose, open and porous, it is shallow. During wet seasons, or periods of heavy rainfall, it soon becomes saturated with water, and any additional water that falls must run off into the streams that drain the area. Run-off water when flowing rapidly, as it does down steep slopes, causes severe erosion. When this survey was made, practically all areas of Gilpin soil other than those covered by forests had been damaged by erosion. Approximately one-fourth of the total cleared area of Gilpin (Ashby) soil had been eroded so badly that it can no longer be used for cultivated crops.

Natural Vegetation: The natural vegetation originally was of the oak-pitch pine forest type that contained scarlet, red, and white oaks. The dominant pines were pitch, white and Virginia scrub. In this forest there were also some soft maple, hickory, wild cherry, ash, and other associating species. In the deep ravines where there was more moisture, with good stands of hemlock, birch, maple, and beech frequently were found. The ground cover consisted of blueberries, huckleberries, and some mountain laurel.

Fig. 17.—A cross-section of Gilpin soil where it has been under cultivation for a number of years. The average soil depth is about 18 inches.

In old abandoned fields the dominant plant growth now is Virginia scrub pine, brambles, and poverty grass. The re-establishment of hardwoods on abandoned areas of Gilpin (Ashby) soil is very slow and questionable even when seedlings are planted.

Natural Fertility: The parent geological formations from which the Gilpin (Ashby) soil is derived are naturally deficient in those minerals and nutrients that plants must have in relatively large quantities; therefore, this soil also is deficient in important nutrient elements, mainly calcium, phosphorus, and potassium. The original forest species were able to tolerate the low fertility of this soil much better than the grass and legume crops that were introduced when white men cleared the forests and plowed the land. Erosion adds to the difficulties encountered when the farmer tries to produce crops on this soil.

Current Use: Approximately half of the Gilpin (Ashby) soil in Fulton county remains under natural forest. Of that portion which has been cleared and plowed, approximately one-fourth has been turned back to nature in the form of "old fields" over which the dominant plant growth is Virginia scrub pine, brambles, and poverty grass. Approximately one-third of the cleared area is occupied by either hay or pasture. The pasture, in most instances, is a transition between hay land and idle fields. The remaining one-third is used for crop production, chiefly small grains, buckwheat, hay, and some corn. The small grain crops

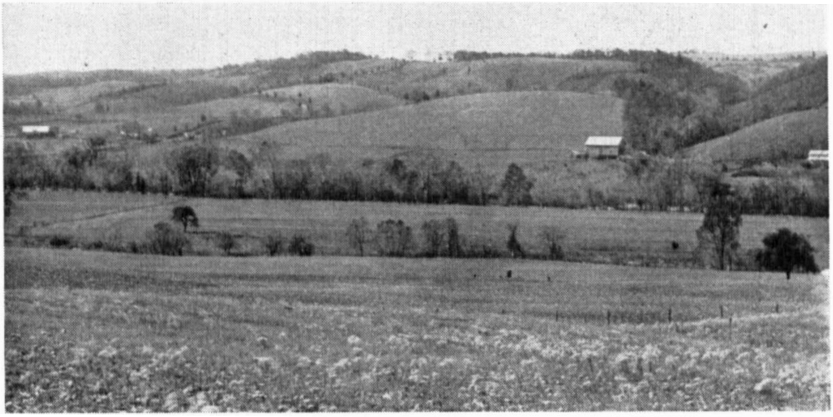

Fig. 18.—Moshannon soil on flood plain of Licking creek. Gilpin soil occupies the shale hills in the background. Photo taken in southeast corner of Fulton county.

are mainly wheat, oats, and buckwheat. Recently winter barley and soybeans have been grown in the region with some success. The main hay crops are red clover and timothy mixed, and occasionally a field of alfalfa where the soil has been heavily limed and fertilized. When the soils were deeper, corn was grown much more extensively than at present. Corn acreage and yields have been gradually declining over all areas of Gilpin (Ashby) soils, mainly because of decreasing fertility and low moisture reserves during the dry, hot periods of midsummer. Per acre yields for the major crops as grown under current practices on the Gilpin

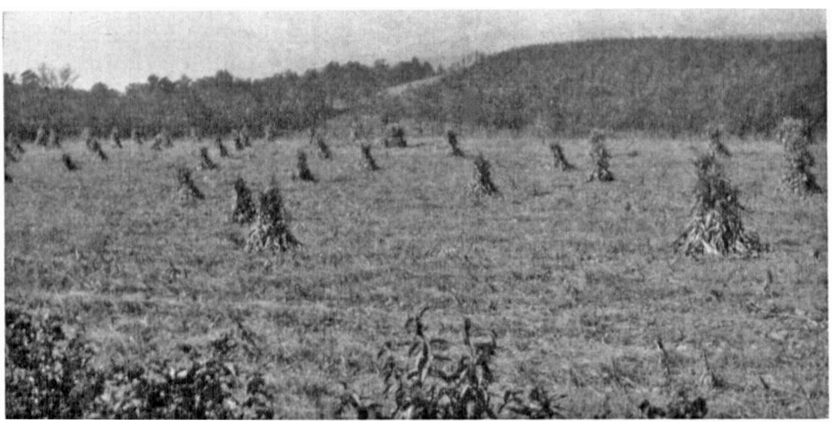

Fig. 19.—Corn on Gilpin soil in foreground. Closed stand of Virginia scrub pine on abandoned field in right background.

(Ashby) soil are; corn, 15 to 30 bushels of shelled grain; wheat, 8 to 15 bushels; oats, 15 to 25 bushels; buckwheat, 6 to 12 bushels; clover-timothy hay, first crop, ½ to 2/3 tons; and for alfalfa, where limed and fertilized, approximately ¾ to 1¼ tons.

Practically all pastures are of very poor quality and consist of volunteer clover and timothy with possibly some red top or orchard grass which may have been added to the clover and timothy seedings.

Future Use Possibilities and Limitations: The future use of Gilpin (Ashby) soil is questionable and unpredictable unless erosion is controlled; many areas have already been so badly damaged by erosion that crop production on these areas is beyond present economic possibilities. They should be returned either to permanent grass or forest; in fact, if the Gilpin (Ashby) soil is to be retained for agriculture approximately two-thirds of the cleared land should be placed under continuous grass or hay and only the more level and deeper areas used for small grains and cultivated crops.

In general, the agriculture, throughout the area occupied by Gilpin (Ashby) soil, is of a subsistence type built around general farming and the growing of those crops that can either be sold for cash or fed to animals. The cash crops are mainly wheat, buckwheat, and clover seed. All other crops (corn, oats, hay) are fed to livestock kept on the farm.

With the natural fertility low, crop production necessitates liberal applications of both lime and fertilizers. Organic matter reserves of this soil are very low, therefore all available farmyard manure should be hauled to and spread on fields. Then in addition, cover crops should be grown and plowed under for the purpose of adding organic matter to the soil.

The Amberson Soil Series

Origin of Soil Material: This residual soil was derived through the physical disintegration of acid, gray and brown, silty shales. The main geological formations that contribute soil materials are the contact or interbedded layers of the Catskill and Chemung shales. The Catskill shale is brown to reddish brown in color and the Chemung shale is from yellowish gray to brownish gray. Both are acid and the alternate beds or strata of these formations may range in thickness from 5 to 50 feet. Wherever these shales are exposed at very steep or vertical angles, plowed fields of this soil appear streaked with alternate grayish brown

and reddish brown stripes. To be specific, the Amberson series is a Gilpin-Calvin complex, the areas of each soil being too small to be shown accurately on most soil maps.

Topography and Physiography: Amberson soil occupies rolling to hilly land where the steepness of the slopes ranges from 5 to 60 per cent with most of this soil occupying slopes of 10 to 30 per cent. Amberson soil usually is found in a narrow belt or strip between areas of Gilpin and Calvin soils.

Development: Amberson soils are predominantly of the A-C profile type but include areas having A-B-C profiles, the (B) horizon being only mildly developed. In general, Amberson soil, like Gilpin (Ashby) and Calvin, is shallow; that is, the soil depth rarely ever exceeds 30 inches. On very steep slopes, the depth may not average more than 15 or 20 inches to weathered shale. It is a grayish-brown forest soil which is strongly acid throughout.

Description: A typical or true description of Amberson soil is difficult because of the great variety of colors of parent shale materials. The following description will apply to most areas as found under forest cover:

A_{00} Litter layer—Natural litter is mainly leaf material from oak-pitch pine forest.

A_0 Humus layer, 0 to 1 inch—The top layer is a dark brown to nearly black, spongy but fibrous, humus mat of the "duff" type. This layer is strongly acid, pH 5.0 to 5.4.

A_1 Horizon, 1 to 2½ inches—The second layer is composed of grayish brown to dark brown, loose, mellow silt loam having little structure. This soil contains numerous sub-angular pieces of weathered shale and is strongly acid, pH 5.0 to 5.2.

A_2 Horizon, 2½ to 10 inches—The material of this leached horizon varies in color from brown to grayish yellow. Its texture is shaly silt loam and its structure is of the single grain type. Small weathered shale fragments are plentiful throughout.

A_3 Horizon, 10 to 14 inches—This is the transition zone between the A_2 and C horizon except where there is a mildly developed (B) horizon.

C_1 Horizon, 14 to 22 inches—At the 14 to 22-inch depth, the soil is a grayish yellow to yellowish brown, shaly, loose, porous, non-plastic silt loam 10 to 30 per cent of which is sub-angular weathered shale fragments.

C_2 Horizon, 22 to 30 inches—This horizon is practically the same as C_1 except 20 to 60 per cent of the soil mass is sub-angular platy, shale fragments that may be as much as 1½ or 2 inches across.

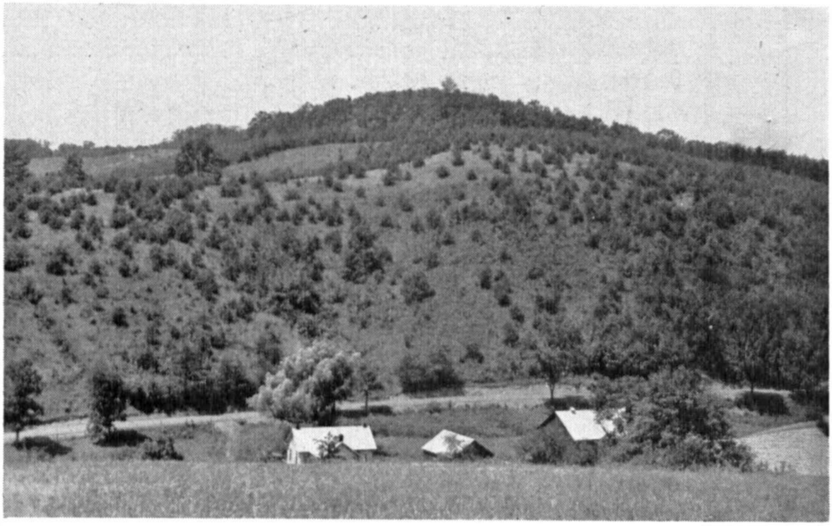

Fig. 20.—A typical illustration showing encroachment of scrub pine on old fields in shale hill sections of south-central Pennsylvania.

If the soil material of the C horizon has been derived from the Catskill shale, its color will be brown. If it is derived from the Chemung shales, the color is generally yellow.

The color and fertility of the surface soil varies in accordance with the color of the parent soil. In general, the more brown the surface soil, the more productive it will be when planted to farm crops. The total depth of this soil varies from 8 to 10 inches to 25 or 30 inches but averages from 18 to 20 inches.

Total Area and Location: The total area of Amberson soil in Fulton county may be as much as 60 square miles, the most of which occurs as narrow belts between the Gilpin (Ashby) and Calvin soils. (See Soil Map). Extensive areas of the Amberson series are known to occur throughout the "shale hill" sections of south-central Pennsylvania.

Surface Drainage and Erosion: Surface drainage for Amberson soil is excessive and erosive, and may be compared to that of the Gilpin (Ashby) series.

Natural Vegetation: The natural forest is of the oak-pitch pine type, that is very similar to that found on the Gilpin (Ashby) soil. On "old fields" or abandoned areas of this soil, the dominant vegetative growth is Virginia scrub pine, brambles, golden rod, and poverty grass.

Natural Fertility: Amberson soil, as normally developed, has a fertility level slightly lower than that of Calvin. Amberson soil

is strongly acid, pH 5.0 to 5.5. It is deficient in calcium, phosphorus, potassium, nitrogen, and other important elements. The organic humus reserve in cultivated areas of this soil is very low.

Current Use: Approximately one-fourth of this soil as found in Fulton county remains under forest cover. About one-fourth has been cleared, farmed, and allowed to go back to "old fields" that are now being overgrown by scrub pines, weeds, and poverty grass. The remaining half is in general farm crops and unimproved pasture. The major crops are corn, wheat, oats, rye, barley, buckwheat, soybeans, and mixed clover and timothy hay. The yields of these crops are, in general, about midway between those on the Gilpin and Calvin soils. The farming is of a subsistence type similar to that on the Gilpin (Ashby) soil areas.

Future Use Possibilities and Limitations: Amberson soil, because of its natural low fertility, can not be expected to produce agricultural crops unless it receives liberal applications of lime, manure, and fertilizer. If these materials are applied, the next limiting factor will be soil moisture. Wherever the soil has been thinned by erosion, or it is normally shallow, crop yields are often reduced during the dry summer months because of insufficient moisture storage. This is especially true wherever the soil is less than 2 feet deep. Crop production on Amberson soil should be grasses and legumes for hay or pasture. Corn production should be restricted to the more level and deeper areas for corn is a soil depleting crop in that plowing and cultivation promotes excessive soil erosion.

Fig. 21.—This farm home and buildings are typical of those found on the better areas of the Calvin, Amberson, and Gilpin soils. Calvin soil in foreground, Gilpin (Ashby) soil in background.

Soil Group V. Stony Soils of the Steep and Rugged Mountain Areas

This group of soils is confined almost entirely to steep and rugged mountains. All of these soils are stony, strongly acid, and low in natural fertility. Some are extremely low in plant nutrients. Practically all areas of these soils are occupied by native forests. The differences found in these soils are mainly in type of profile, soil color, and kind of rocks or minerals from which they were derived. The Dekalb, Clymer, Lehew, and Leetonia series comprise the residual soils of the mountain areas. Colluvial soil accumulations were found on the lower slopes of the mountains, and at the edges of the valleys. These colluvial soils, as classified, include the Laidig, Grafton (Andover) and Hayter series. All of these soils, residual and colluvial, are derived from massive sandstone formations that have upheld the mountain areas for thousands of years. These soils are more or less sandy, and some have remained in place so long that their surfaces have been leached to a grayish brown or gray. The oldest and most acid soil in the county is the Leetonia series, a podsol soil that has weathered until its A_2 horizon is nearly white, little being left but white quartz sand. Next in order are the Dekalb and Clymer soils which are very acid, but not as low in fertility as the Leetonia soil. The Lehew series is derived from soil materials produced by the disintegration of brown and red sandstones from which the soil inherits its brown color. It has a higher fertility level than soils derived from gray or yellow sandstones.

In general all of the soils in this group are forest soils and will be so considered in this report.

Sub-Group A. Residual soils of the mountain areas.—Included in this sub-group are the Dekalb, Clymer, Leetonia, and Lehew series. All these soils are well drained, very acid, and sandy.

The Dekalb Soil Series

Origin of Soil Material: This well drained, strongly acid, residual soil was derived from acid, gray, and brownish yellow sandstones. The main geological formations that contributed materials for this soil are the Oswego, Tuscarora, Pocono, and Pottsville sandstones, all of which are either gray, yellowish gray, or brownish gray in color.

Topography and Physiography: Dekalb soil occupies the steep mountain slopes of the high mountain and plateau regions of Pennsylvania.

Fig. 22.—Cross-section view of Dekalb soil. The thick overhanging acid humus mat is typical of the forest humus layer that covers and protects the steep forest lands from erosion.

Development: It is a brownish gray or yellowish gray forest soil that possesses an immature profile mainly because the soil has never been allowed to develop beyond the A-C profile type.

A_{00} Litter layer—The leaf litter is mainly frcm oak-chestnut-pitch-pine forest. All litter materials are strongly acid.

A_0 Humus layer, 0 to 1 inch—This very dark brown to black, very acid, tough, mat-like accumulation of peaty but spongy "duff" type of humus can be easily lifted from the soil because it is not intermixed with the surface mineral soil. This humus is very acid, having a pH of 4.8 to 5.0.

A_1 Horizon, 1 to 2½ inches—Below the humus is a strongly podsolized, salt-and-pepper colored soil material into which small particles of humus have been deposited largely by frost action. This layer is very sandy and acid, pH 4.7 to 4.9.

A_2 Horizon, 2½ to 10 inches—A pale yellow to grayish yellow, structureless sandy soil having practically no organic matter in it is found from 2½ to 10 inches. This horizon has undergone severe leaching, is very low in fertility, and is very acid, pH 4.7 to 4.9.

A_3 Horizon, 10 to 14 inches—This is the transition horizon between the A_2 and the C horizons; the soil in this horizon is being subjected to the processes of alluviation and leaching.

C_1 Horizon, 14 to 20 inches—Brownish yellow sandy loam soil prevails at this depth. In places where drainage is exception-

ally good, the soil may be pinkish yellow but otherwise it is brownish yellow. There is no structural development, and the soil is strongly acid, pH 4.9 to 5.2.

C_2 Horizon, 20 to 30 inches or deeper—Below 20 inches, the soil is very much the same as that of the C_1 horizon but less acid. It is more brown, the color usually approaching that of the parent rocks from which the soil was derived. The acidity of the lower C horizon is approximately pH 5.0 to 5.5. Dekalb soil contains great quantities of stone; in fact, for most areas from one-third to half of the soil mass is angular stones.

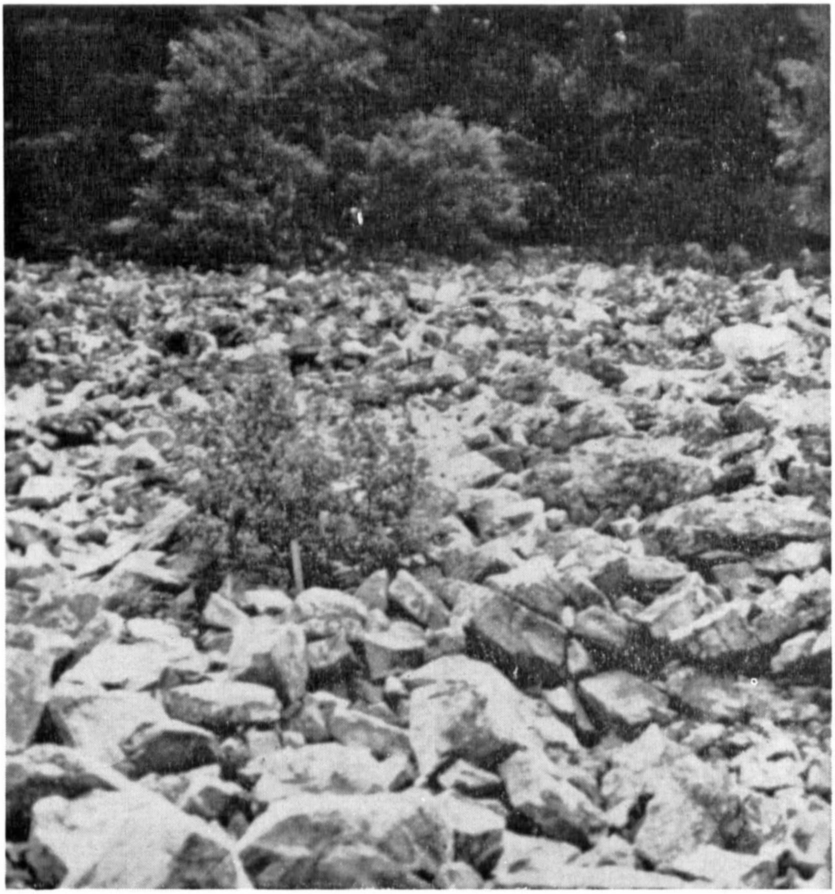

Fig. 23.—Rough, stony land. Many of the steep and rugged high mountain areas are covered by a continuous cover of broken sandstones.

Total Area and Location: Dekalb soils occupy the steepest and most rugged high mountain lands in the county. Wherever the symbol, "R-ST" (rough stony land) appears on the soil map, and in many places not so designated, the soil is buried under great quantities of stone. Some rugged mountain tops are nothing but masses of huge boulders, fig. 23.

Surface Drainage and Erosion: Surface drainage of Dekalb soil is very rapid and excessive. As long as it is protected by forests, there will be no serious erosion, but if this soil is ever deprived of its vegetative cover, by forest fires or other causes, the rate of erosion will be very rapid and destructive.

Natural Vegetation: The forest cover is mainly of the oak-chestnut-pitch pine type. The more important oaks are chesnut oak, and post oak, with some red oak and scrub oak. All chestnut trees were destroyed between 1910 and 1920 by the chestnut blight. At present only a very few of the remaining roots have been able to send up new sprouts and these have been attacked and killed by this disease before they have become large enough to produce chestnuts in quantities beyond what may be considered rare specimens. Of the softwoods, pitch pine is most important but white pine is also present on the lower mountain slopes or on sites where the soils are both deep and moist. In this forest type on cool, moist sites, some soft maple, birch, poplar, hemlock, and other species also occur which have the ability to tolerate very acid soils that have low fertility. Undergrowth is mainly mountain laurel, huckleberry, and blueberry bushes.

Natural Fertility: Dekalb soils, except for one or two other series, have the lowest natural fertility of any soil in the state. Dekalb soil is very acid, and its moisture-holding capacity is limited because of its stoniness and shallow depth.

Current Use: Forests, recreation, and wildlife preserves constitute the major uses of Dekalb soil.

Future Use Possibilities and Limitations: It is not likely that present uses for this soil series will change rapidly. The forests should be protected from fire. Harvest of saw logs should be restricted to a systematic cutting of mature trees. Clean cutting does not leave seed trees essential to the regeneration of a new forest.

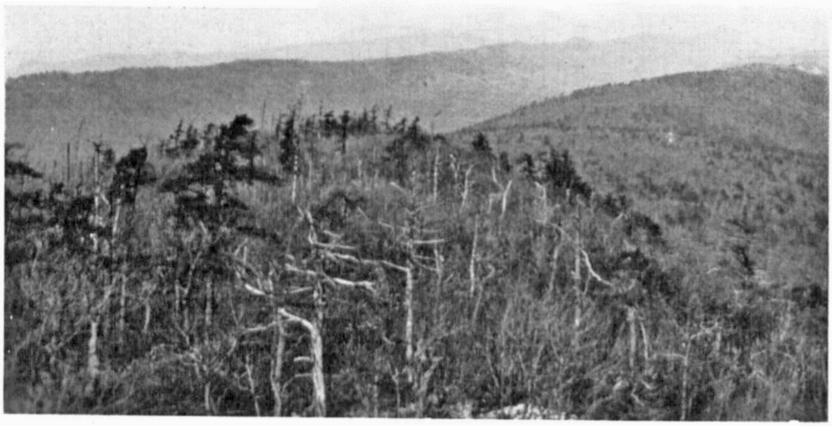

Fig. 24.—Typical topography and vegetation of Dekalb soil on the high mountain areas in Fulton county. Forest cover is dominantly oak and pitch pine. View is north from Big Mountain fire tower which is on Tuscarora mountain east of McConnellsburg.

The Clymer * Soil Series

Origin of Soil Material: The Clymer series is a well drained residual soil derived from acid, gray, and brownish yellow sandstones. Important geological formations that contributed to the origin of this soil are the Oswego, Tuscarora, Pocono, and Pottsville sandstones. All are brownish yellow except the Tuscarora which is very light gray to nearly white.

Topography and Physiography: The Clymer series is nearly always found on the more level areas on the tops of high mountains or plateaus where geological erosion has not disturbed the normal accumulation and development of a deep soil.

Development: The environment of the accumulated material has been such that the soil has developed an A-B-C profile which, in many respects, is approaching equilibrium with the environment of the region. It is strongly podsolized, yet it does not possess the typical ashy gray A_2 horizon or the coffee brown B horizon which is normal for the fully mature Leetonia podsol soil that is found in close association with the Dekalb and Clymer soils.

Description: Clymer soil is a well drained, strongly acid, brownish gray forest soil possessing an immature A-B-C profile. The following profile description is typical of the Clymer soil as it is found on the high mountains and plateaus of Fulton county.

* The Clymer series was called Dekalb in the older surveys.

A_{00} Litter layer—The acid forest litter layer that covers this soil is mainly from the oak-chestnut-pitch pine forest that occupies this soil.

A_0 Humus layer, 0 to 1 inch—A very dark, brown to black, tough, peaty, humus mat of the "duff" type comprises this layer. It is strongly acid, pH 4.9 to 5.5.

A_1 Horizon, 1 to 2½ inches—This horizon contains strongly podsolized, sandy textured, mineral soil into which there has been mixed, largely by frost action, small particles of the overlying black humus which gives to the soil a very dark brownish gray, salt-and-pepper color. The soil of this horizon has a single grain structure.

A_2 Horizon, 2½ to 12 inches—The sandy loam soil of this horizon is from pale yellowish gray to grayish yellow. It is open, porous, and possesses a single grain type of structure. It is the most acid horizon in the profile, the pH reaction varying from 4.8 to 5.0.

A_3 Horizon, 12 to 15 inches—In the transition zone between the A_2 and B horizons, the soil material has undergone aggressive alluviation and leaching but it has not been leached as severely as the A_2 horizon.

B Horizon, 15 to 28 inches—In this horizon much of the clay and finer silt removed from the A horizon has concentrated, thereby giving rise to a yèllowish brown, sandy, silty, clay loam having an imperfectly developed, sub-angular, small nut structure. This soil is open and porous, and movement of water through it is rapid. The acidity of this horizon varies from pH 5.0 to 5.5.

C Horizon, 28 to 40 inches or more—A yellowish brown to drab-colored sandy loam soil extends down to the Oswego, Pocono, or Pottsville sandstone.

Clymer soil as found on the mountain tops of Fulton county is a stony soil. In most places the content of stone is too great to permit the clearing of this soil for agricultural use. As mapped in Fulton county, this soil contains a few small imperfectly drained areas which in detailed surveys would have been classified under the Cookport series.

Total Area and Location: The total area of Clymer soil is small. Practically all of it is on the top of Broad Top Mountain which is in the northwest corner of the county.

Surface Drainage and Erosion: All areas of Clymer soil have very good surface drainage yet the rate of water run-off is usually not rapid enough to cause erosion.

Natural Vegetation: The forest cover is of the oak-chestnut-pitch pine type. The dominant oaks are chestnut or rock oak while scarlet and red oak are less abundant. Extensive areas of scrub oak were found on this soil where it had been repeatedly cut or burned over. This soil originally supported a thick stand of large chestnut trees but they have all been killed by the chestnut blight. Pitch pine dominates the pine group but fair stands of white and red pine were found growing on areas which have escaped forest fires.

Natural Fertility: Clymer soil, like Dekalb, is very low in natural fertility. The soil material, as derived from the sandstones, is deficient in all important plant nutrient elements. Clymer soil, except for Leetonia, is probably the oldest soil in the area. It has undergone thousands of years of weathering and leaching, and naturally it is very acid, pH 5.0 to 5.2.

Current Use: Most areas of this soil are occupied by hardwood forest. A few areas are devoted to either recreation, or wild game preserves.

Future Use Possibilities and Limitations: The future use of this soil, because of its low fertility, great acidity, and stoniness will no doubt be for the production of forests in which there will probably be located game refuges and recreation areas.

The Leetonia Soil Series
(The Podsol Soil of the Region)

Origin of Soil Material: Leetonia is a residual soil derived from acid, gray Tuscarora sandstone materials. Some exposures of this sandstone are nearly white.

Topography and Physiography: Leetonia soil is most frequently found on the tops of high mountains and in very close association with exposures of the Tuscarora sandstone.

Description: The Leetonia soil is a true Podsol that has been developed from residual soil derived from sandstones. It is the oldest and most acid soil in the state, and there is no soil in Pennsylvania that has a lower fertility level. Its profile may be described as follows:

A_{00} Litter layer—The forest litter is mainly from stands of mixed oak, chestnut and pitch pine. It is very acid.

A_0 Humus layer, 0 to 1½ inches—This humus layer is a black, extremely acid, tough, fibrous "duff" type of mat which can be removed from the soil in large sheets that range in thickness from

1 to $1\frac{1}{2}$ inches. The acidity of this humus mat ranges from pH 4.5 to 4.8.

A_1 Horizon, $1\frac{1}{2}$ to 3 inches—This is a dark gray, very sandy horizon. Small particles of black humus have been mixed with the white sand, mainly by frost action, until this horizon resembles a mixture of salt and pepper. In reaction it is very acid, pH 4.6 to 4.9.

A_2 Horizon, 2 to 6 inches—This ashy gray, extremely acid, sandy layer between the depths of 2 to 6 inches is gray in color when wet, but when dry it is nearly white. This horizon has been so severely leached by water containing organic acids that little is left but white quartz sand. The podsolic leaching process has been so severe in the A_1 and A_2 horizons that the iron has been dissolved and removed leaving only the insoluble quartz sand.

B Horizon, 6 to 8 inches—This coffee brown horizon varies in thickness from 1 to 3 inches, its color being due to a concentration of coffee brown iron humus colloids.

C Horizon, from 8 inches downward—The grayish-yellow or pale yellowish-brown sandy soil contains appreciable quantities of coarse sand. The C horizon includes the parent soil material as derived from the acid, gray Tuscarora sandstone or other sandstones having similar characteristics. In chemical reaction, the C horizon ranges from pH 5.0 to 5.3; it becomes slightly less acid as the depth of the soil becomes greater.

The total depth of the Leetonia soil varies from 3 to 6 or more feet. All areas in Fulton county contain large quantities of sandstone, some of which are huge boulders weighing several tons.

Total Area and Location: Not more than 5 square miles of the Leetonia soil was found in Fulton county and this is located on the more level tops of the mountains or plateaus where geological erosion has not interfered with the development of a true podsol.

Surface Drainage and Erosion: Both surface and internal drainage are excessive. Practically all the water that falls on this soil drains down through it very rapidly. There is little or no surface run off and erosion is unimportant.

Natural Vegetation: The vegetative cover is of the oak-chestnut-pitch pine type with scrub oak dominating on most areas. In the past chestnut, pitch pine, and chestnut oak were the most abundant trees. The undergrowth and ground cover is primarily a thick stand of mountain laurel and huckleberries, or blueberries and some azaleas.

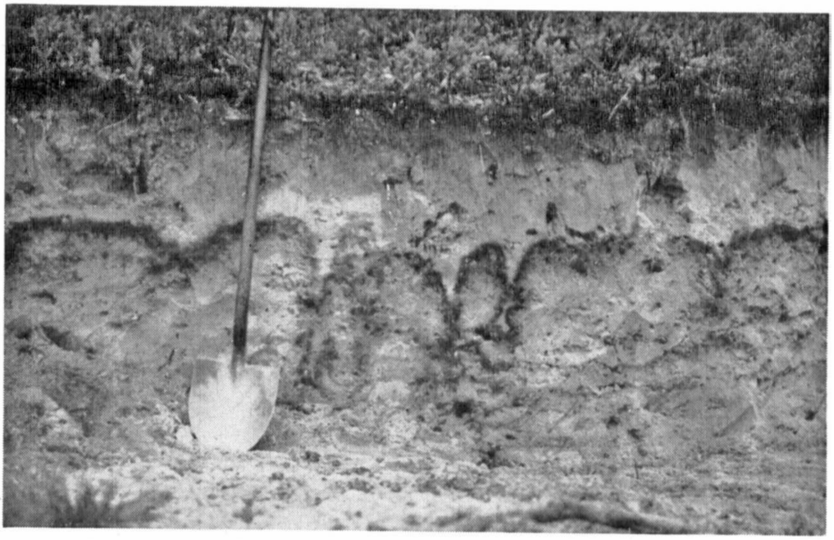

Fig. 25.—Cross-section view of a well developed Leetonia podsol soil. The surface soil is extremely acid and has been leached until it is nearly white.

Natural Fertility: The natural fertility of the Leetonia podsol is the lowest of any soil in the state.

Current Use: It is largely the soil of the scrub oak "brush land" often referred to as "the barrens". Some areas have been set aside for game preserves but such areas produce plant growth that has but little nutritive value for any kind of animal life.

Future Use Possibilities and Limitations: The only possible use for tracts of this soil is for forest and game preserves. At best it can never be very valuable because of its extremely low fertility.

The Lehew Soil Series

Origin of Soil Material: This well drained residual soil was derived from acid brown and reddish brown, fine grained sandstones. The Juniata and the upper members of the Catskill and Mauch Chunk geological formations contributed the materials from which the Lehew soils have been developed.

Topography and Physiography: Lehew soil is usually found either high up on steep mountain slopes or in the saddles and terraces of the high mountain areas. In south-central Pennsylvania, Lehew soil is nearly always found bordering Dekalb.

Development: Lehew soil usually possesses an A-C profile, but on the more level and deeper areas an imperfectly developed B

horizon is frequently found. The A-(B)-C profile equivalent of Lehew will probably be called Ungers, in later surveys. Its internal drainage is excellent.

Description: This well drained, brown forest soil is derived from acid, brown and reddish brown sandstones. A profile description of Lehew soil as found in south central Pennsylvania is:

A_{00} Litter layer—The forest litter mainly is of the oak-maple-white pine type, the dominant oaks being red and scarlet which make up 60 to 80 per cent of forest stands.

A_0 Humus layer, 1 to 1½ inches—The surface is composed of dark brown, medium granular to spongy humus which is medium acid pH 5.4 to 5.8. The looseness of the humus indicates considerable insect activity.

A_1 Horizon, 1½ to 3 inches—The pinkish gray to grayish brown sandy loam soil of this layer shows evidence of podsolization in the contact zone between the A_0 and the A_1 horizons. The structural aggregation of the material is of a loose, fine crumb type. Reaction ranges between pH 5.4 and 5.8.

A_2 Horizon, 2 to 10 inches—This pale grayish to yellowish brown, leached horizon is usually a fine sandy loam. The structure is of the single grain type. The soil material is open and porous and provides for a very rapid absorption of water. This is the most acid horizon, the reaction ranging between pH 5.2 and 5.4.

A_3 Horizon, 10 to 14 inches—This is the leached transition zone between the A and C horizons or the A and the mildly developed (B) horizon.

(B) or C_1 Horizon, 14 to 30 inches—The soil in this horizon is a brown to reddish brown sandy to silty clay loam which in many places is sufficiently aggregated to give rise to an easily separated, fine, irregular nut structure. The reaction of this horizon ranges between pH 5.5 and 6.0.

C_2 Horizon, 30 to 60 inches or deeper—The C_2 horizon soil is a reddish brown, sandy or gritty, silty clay loam in which the structural aggregation is not as well developed as in the (B)-C_1 horizon. The reaction of the C_2 horizon ranges between pH 5.7 and 6.2. Weathered fragments of fine grained sandstone and coarse textured shale are abundant in all horizons of this soil.

In total depth, the Lehew soil varies from 2 to 10 feet or more, and it averages between 4 and 6 feet.

Total Area and Location: There are approximately 60 square miles of Lehew soil in Fulton county, all of which is located on steep slopes, in the saddles, or on the terraces of high mountain

ridges. In distribution, Lehew soils are limited to the Appalachian ridges and valleys of south-central Pennsylvania, western Maryland, eastern West Virginia, and northwestern Virginia.

Surface Drainage and Erosion: Surface drainage of Lehew soil is very rapid because it occupies steep slopes. As long as this soil is occupied by forest and a deep leaf litter covers the soil, there will be little erosion. If it ever is burned over or cleared, erosion will be severe in spite of its ability to absorb rainfall rapidly.

Natural Vegetation: Natural forest cover is of the oak-chestnut-pine type with red, scarlet, and chestnut oaks dominating. The chestnut has of course been eliminated by chestnut blight. White pine dominates among the soft woods but some pitch pine occurs on the more exposed and dryer sites. There is little undergrowth or ground cover on Lehew soil possibly because the tall dense tree growth provides too much shade for low growing vegetation. It is without doubt the most productive, residual, forest soil in south-central Pennsylvania. The forest canopy on it rises 10 to 30 feet above that on Dekalb, Clymer, or Leetonia soils.

Natural Fertility: The natural fertility of Lehew soil is the highest of any of the residual mountain soils in south-central Pennsylvania, because it is derived from parent sandstones that contain more of the mineral elements that are essential for normal plant growth.

Current Use: Practically all of the Lehew soil, because of its stoniness and steepness, remains under natural hardwood forest cover.

Future Use Possibilities and Limitations: The best possible use for this soil is the production of forests. It has natural depth and nutrient reserves necessary for the growth of valuable oak and pine timber. Forests on this soil should be protected from fires. They should be managed in accordance with the best forest management practices.

Sub-Group B. Transported or colluvial soils at the base of steep mountain slopes. At the bases of most of the mountains in south-central Pennsylvania, which includes Fulton county, extensive areas of transported or colluvial deposits of stony soil materials have accumulated. These deposits were brought down from higher elevations by the combined forces of gravity, frost, snow slides, mud flows, and possibly by land slides. At present there is little movement of materials down these slopes for all of the higher mountain areas are covered by forests. It is be-

lieved that most of this movement of soil took place during the ice ages when the climate was so cold that little or no vegetation grew in this region. With vast snowfalls accumulating over the mountains during the Ice Age, it is logical to assume that snow creep and snow slides, may have moved appreciable quantities of soil from the higher to the lower mountain slopes. Water from melting snow may have played an important role in the movement of loose soil to the lower slopes of the mountains where we now find the largest areas of colluvial soils.

The soil material in these colluvial deposits is usually very similar to that of the residual soils located immediately above areas of these soils. In general, the deepest deposits are in the narrow mountain coves or along the north sides of the mountains where the snowfall probably accumulated to greater depths than on the south sides where thawing occurred more frequently.

These colluvial soils comprise only two major groups. One group includes the gray-brown and yellow-brown materials coming mainly from areas of Dekalb, Laidig, and Grafton (Andover) series. Laidig soil is deep and well-drained. Grafton soil is a shallow, imperfectly drained phase of Laidig. Both soils are strongly acid and they contain large quantities of loose stone; in fact, these soils have no agriculture value unless great quantities of stone are first removed. The second group includes brown and reddish brown colluvial materials brought down from the higher areas of Lehew soil. The Hayter soil series as mapped in this survey includes all the soil in this group.

The Laidig Soil Series

Origin of Soil Material: Well drained, stony, colluvial, deposits compose the Laidig series. The soil material was transported to its present location from higher areas of strongly acid Dekalb, Clymer, and Leetonia soils which were originally derived from gray, yellowish gray, and brownish gray, acid Tuscarora, Oswego, Pocono, and Pottsville sandstones.

Topography and Physiography: Laidig soil occupies the lower and less steep portions of long and steep mountain slopes and narrow, mountain cove areas where colluvial deposits have concentrated from surrounding mountains. In general, Laidig soil occupies slopes ranging from 10 to 30 per cent and averaging between 15 and 25 percent.

Development: It is a well drained, acid grayish-brown, forest soil that has an A-B-C profile. A profile description of the Laidig series, typical of the soil as mapped in Fulton county follows:

A_{00} Litter layer— The forest cover is of oak-pine type, but approximately 90 per cent of the leaf litter comes from oak trees.

A_0 Humus layer, 0 to 1 inch—A very dark brown to black, platy, acid, humus mat covers this soil. The humus mat is strongly acid, pH 5.0 to 5.4.

A_1 Horizon, 1 to 3 inches—This dark brownish gray layer of sandy loam soil exhibits marked evidence of podsolization. It has single grain structure and is strongly acid, pH 5.0 to 5.4.

A_2 Horizon, 3 to 12 inches—This brownish yellow to light cinnamon brown, sandy loam layer is open, porous, and has a single grain type of structure. It is the most acid horizon, pH 4.8 to 5.2.

A_3 Horizon, 12 to 15 inches—In the lower A horizon or transition zone between A_3 and B horizons, the soil color becomes darker brown with increasing depth.

B Horizon, 15 to 28 inches—This horizon of yellowish brown to pinkish brown or reddish brown, sandy, silty clay loam soil possesses an imperfectly developed, soft, sub-angular, small nut to coarse granular structure. Where the subsoil drainage is excellent the soil color varies from pinkish brown to reddish brown, but where it is restricted, the soil color is generally brownish yellow. The B horizon is open, porous, and friable, and water moves freely through it. The acidity of this horizon ranges between 5.4 and 5.8.

C Horizon, 28 to 40 inches or deeper—A yellowish brown to brownish yellow, loose, sandy, soil which is open, porous, and well drained extends to the underlying shales. The acidity of this horizon ranges between 5.4 and 5.9.

The total depth of this soil varies greatly, from 5 to 30 or more feet, but averages between 8 and 12 feet. This soil rests on the upturned edges of massive shale formations. It is a stony forest soil. It is too stony for agricultural use unless large quantities of stone are removed from the surface. Laidig soil, as mapped in Fulton county, contains a few small areas which are imperfectly drained.

Total Area and Location: There are approximately 50 square miles of Laidig soil in Fulton county. The largest and most extensive areas are along the lower slopes of Tuscarora and Cove mountains. Other areas are located on the lower slopes of the higher mountain ranges in the northwest corner of the county.

Surface Drainage and Erosion: Surface drainage is very good. To date very little of this soil has been subjected to erosion for most of it is under forest cover. This soil is open and porous and will absorb rainfall rapidly.

Natural Vegetation: The native forest is primarily of the oak type but includes beech, maple, hickory, white pine, hemlock, yellow poplar, wild cherry, and other species commonly found in association with this type of forest. The oaks are mainly red and scarlet with some chestnut and white oak. Red oak, white oak, and white pine are the most valuable tree species found growing on this soil. The fertility of this soil in certain cove areas is high enough to support some black walnut. Flowering dog-wood trees are fairly abundant on this soil but were practically non-existent on Dekalb, Clymer, and Leetonia soils. This soil is, without question, one of the most valuable and most productive forest soils in the county.

Natural Fertility: Even though this soil is derived mainly from acid sandstone materials, it has over a period of thousands of years accumulated plant nutrients until it may be classed as a medium fertile soil insofar as forest tree growth is concerned. Agriculturally its fertility level would be very low if cleared and cultivated.

Current Use: Practically all of this soil is under native forests.

Future Use Possibilities and Limitations: Laidig soil, because of its stoniness, will no doubt remain in forest for many years and unless a great need for crop land should arise in this area, this soil will serve its best purpose if it is allowed to produce timber. It is a very excellent forest soil and if properly managed will produce excellent yields of valuable forest products for many generations.

The Grafton Soil Series *

Origin of Soil Material: Grafton soil, as mapped in Fulton county, includes areas where colluvial material is spread as a thin mantle over weathered shales. This transported material came from higher areas of Laidig and Dekalb soils. The underlying residual soil and shale materials have been derived from the upturned edges of acid shale formations.

Grafton soil resembles Laidig in that it is stony, acid, and grayish brown in color, but it differs in being shallower in depth and possesses imperfect drainage in early spring because of seepage water coming down from higher areas of Laidig and Dekalb soils. In midsummer when the flow of seepage water from higher areas stops, the soil has reasonably good internal drainage.

* The name "Grafton" as used on the soil map and in this bulletin is not an official correlation name. At the time of this publication there was no officially correlated series name for this soil. The name "Andover" has been proposed.

Topography and Physiography: Grafton soil is at the foot of long steep mountain slopes, where slope gradients vary from 10 to 20 per cent.

Development and Description: The Grafton series is a brownish gray, strongly acid, imperfect to well drained, stony soil which possesses an imperfectly developed A-(B)-C profile. It is a transition soil that occurs between areas of Murrill and Laidig where the transported material becomes shallow and lies on the upturned edges of acid shales.

The surface soil is a brownish gray, stony sandy loam to a depth of 6 or 8 inches. The subsurface is brownish yellow below 10 inches. The total thickness of the transported layer varies from 1 to 4 or 5 feet and this material rests on weathered residual shale.

The entire soil from the surface downward is strongly acid and low in fertility.

Total Area and Location: There are approximately 10 square miles of the Grafton soil in Fulton county, practically all of which is located on the lower slope of Tuscarora and Cove mountains.

Surface Drainage and Erosion: The rate of surface water run-off is rapid and erosive wherever areas of the Grafton soil have been cleared.

In the spring months it frequently becomes saturated with water coming down from higher areas as a result of melting snow, heavy rains, etc. If rain falls on a soil that is already saturated with water, the additional water must run off; this causes erosion on cleared areas of this soil.

Natural Vegetation: The native forest cover is and was mainly oak, beech, maple, white pine, and hemlock.

Natural Fertility: The natural fertility of Grafton soil is low because of the leaching which it receives from great quantities of water that move through it.

Current Use: About two-thirds of the land occupied by Grafton soil has been cleared of both trees and stone. About half of the cleared land was idle at the time this survey was made, the remaining areas being used for corn, small grain, and hay production.

Crop yields on the Grafton soils are about one half to one third of those obtained on the bordering Murrill soils.

Future Use Possibilities and Limitations: Wetness in the spring months restricts the use of this soil for the more important cultivated crops. Wetness in winter causes severe losses by frost heaving or lifting of fall-sown small grain crops. For

cleared areas hay or pasture appear to be promising, but these crops will not be very productive unless the soil has been given liberal applications of lime and fertilizer. In regard to the latter, the cost of fertilization must be considered in comparison with yields obtained, for it is important that increases in yields repay expenses involved when lime and fertilizers are applied.

Properly installed diversion ditches to intercept water from higher ground might improve drainage conditions for this soil during late winter and early spring months.

The Hayter Soil Series *

Origin of Soil Material: Deep colluvial deposits that came from higher mountain areas of Lehew soils comprise the Hayter series. This material was originally derived from brown and reddish brown, fine grained shales and sandstones of the Catskill and Mauch Chunk geological formations.

Topography and Physiography: Hayter soil occupies the lower and less steep portions of long and steep mountain slopes. This soil is limited to the edges of valleys of the Appalachian Ridge and Valley physiographic region. The steepness of slope occupied by this soil varies from 10 to 50 per cent but averages between 15 and 30 per cent.

Development: The drainage environment of the Hayter series is very good, and the soil has been in position long enough to allow development of an A-(B)-C profile.

Description: Hayter is a well drained, acid, colluvial, soil developed from materials derived from brown and reddish brown acid sandstones. A generalized profile description of this soil as mapped in Fulton county follows:

A_{00} Litter layer—The forest litter is mainly from mixed forest stands of oak, maple, and white pine. About 75 per cent of the litter is from red oak and scarlet oak; 20 per cent is from other hardwoods, mainly maple.

A_0 Humus layer, 0 to 2 inches—The top layer is dark brown, loose, mellow, crumbly to spongy, medium acid, fluffy humus which has an acidity range of pH 5.8 to 6.0.

A_1 Horizon, 2 to 5 inches—Dark grayish brown to dark brown sandy loam prevails in depths of 2 and 5 inches. This horizon has a loose, imperfectly developed, fine crumb structure, and its acidity ranges between 5.8 and 6.0.

* The Hayter series as mapped in Fulton county is subject to change in name because of new correlations. The series name "Mench" has been proposed for the well drained colluvial A-(B)-C profile. The series name "Kedron" has been proposed for the imperfectly drained equivalent of Mench, or A-B-C type profile.

A_2 Horizon, 5 to 12 inches—This grayish brown to yellowish brown sandy loam horizon has a single grain structure. It is the most acid horizon, pH 5.5 to 5.8.

A_3 Horizon, 12 to 15 inches—This is the eluviated transition layer between the A_2 and the B horizons.

B Horizon, 15 to 28 inches—In this youthful type of imperfectly and unevenly developed B horizon, the soil ranges from yellowish brown to reddish brown in color depending on internal drainage. The reddish brown shades are found in the better drained areas. The texture is a sandy silty clay loam with sufficient aggregation to give this horizon a fine, irregular, soft incoherent nut structure. The soil is porous and permits rapid downward movement of water. Its acidity is somewhere between pH 5.8 and 6.2.

C Horizon, 28 to 60 inches or deeper—The parent colluvial deposit of brown and reddish brown soil material rests on the upturned edges of acid red shales. The acidity of the C horizon ranges between pH 5.8 and 6.4.

Every horizon of Hayter oil contains large quantities of broken fragments of fine grained sandstone or coarse textured sandy shales. Large stones are present on the surface and throughout these colluvial deposits. Occasionally some of the stones are large enough to be classed as boulders which may weigh several hundred pounds.

Total Area and Location: The total area of Hayter soil in Fulton county is approximately 50 square miles, nearly all of which is on the lower slopes of Sidling Hill, Town Hill, and Broad Top mountain all of which are in the western and northern parts of the county. Extensive areas of the Hayter soils are known to occur in Bedford and Huntingdon counties.

Surface Drainage and Erosion: Surface drainage is excellent; however, there is very little run-off from the Hayter soils because they are open, porous, and deep. They absorb rainfall very rapidly.

Natural Vegetation: The native forest cover is mainly of the oak-maple type, the dominant oaks being red and scarlet, with some white and some chestnut oak. Maple, hickory, dogwood, ash, gum, and some yellow poplar trees occur in this hardwood group. Softwoods are mainly white pine, but some pitch pine is found in the dry areas. Hemlock is important on the deeper and wetter areas and on north slopes which remain cool and moist in summer.

Natural Fertility: Natural fertility of Hayter soil is higher than that of the Laidig series, and the Hayter series may be considered the most fertile and most productive stony forest soil in the county. Forest growth on this soil is very rapid. Shade is so dense that little if any ground cover exists other than young trees that are trying to become established in forest stands that already are crowded.

Current Use: Practically all of the Hayter soil is occupied by forest. It is too stony for possible agricultural use unless the loose stones are removed from the surface. A few areas have been cleared but the cost usually has been in excess of returns obtained from crops grown on this soil.

Future Use Possibilities and Limitations: This soil because of its greath depth, good internal drainage, and fertility level is without question the best forest soil in Fulton county. Its best future use will probably be in the production of pine and hardwood timber.

SOILS AND FORESTS *

Large areas of forest land have been cleared to make room for crops and agriculture, but, as of 1940, there still remained in Fulton county approximately 175,140 acres of natural forest. Most of this forest is located on the steep stony Dekalb, Lehew, and Laidig soils. However, there was approximately 72,134 acres of forest on farms in the valleys. Most of the latter was located on the steeper areas of Gilpin, Amberson, and Calvin soils, fig. 26.

The forest: A number of observations and studies of the forest in this region clearily show that the original forest of Fulton county contained some of the finest oak-chestnut-pine trees in Pennsylvania. That forest now belongs to history. The new forest growth is mainly oak, for the chestnut has been all but eliminated by the chestnut blight disease and most of the original pine forest has been cut away.

About 1932, Professor George S. Perry, published a list of the more important trees commonly found in Pennsylvania. During the survey of this area many observations were made to determine the approximate distribution or location of the more abundant species listed by Professor Perry. A summary of those observations follows, including the names of the more important species of trees, their abundance or scarcity, and the soil or site where each species was commonly found:

* This section was prepared in cooperation with H. N. Cope, W. C. Bramble, F. T. Murphey, and W. W. Simonds of the Department of Forestry of the Pennsylvania State College.

Name of Tree *	Quantity	Location
Oak, red (*Quercus rubra*, L.)	Abundant	Limestone Valleys and shale hills and lower mountain slopes
Oak, white (*Quercus alba*, L.)	Abundant	
Oak, scarlet (*Quercus coccines* Muench)	Abundant	Scarce on stony mountain areas
Oak, chestnut or rock (*Quercus prinus*, L.)	Abundant	Shale hills, and stony mountain areas
Oak, black (*Quercus velutina*, Lamb)	Not too Abundant	Shale hills, and limestone valleys
Oak, Post (*Quercus Stellate*, Wang.)	Abundant	Shale hills and stony mountain areas
Oak, scrub chestnut (*Quercus prinoides*, Willd.)	Abundant	High mountain areas, soils extremely acid
Oak scrub (*Quercus Ilicifoldia*, Wang.)	Abundant	
Pine, white (*Pinus Strobus*, L.)	Limited	Limestone valleys and the deeper soils of the shale hills and lower mountain areas
Pine, Pitch (*Pinus rigida*, Mill.)	Fair Quantity	Shallow shale hills and steep stony mountain areas
Pine, Jersey or Virginia (*Pinus Virginiana*, Mill)	Abundant	Shallow, acid droughty soils of shale hills and areas
Hemlock, American (*Tsuga Canadensis*, (L.) Carr)	Abundant	Most humid areas of the valleys and cool mountain areas
Walnut, black (*Juglans nigra*, L.)	Limited	Limestone valleys and the more fertile soils of the shale hills
Hickory, pignut (*carya glabra* (Miller) Spach.)	Limited	Limestone valleys, shale hills and lower mountain areas
Hickory, Shell bark (*carya ovata* (Mill.) K. Koch)	Limited	Deep fertile soils of limestone valleys, shale hills and lower mountain areas
Beech, (*Fagus grandifolia*, Ehrh.)	Limited	Cool moist mountain valleys
Maple, red (*Acer rubrum*, L.)	Not too Abundant	Deep moist soils, cool sites
Maple Sugar or Hard (*Acer saccharum*, Marsh.)	Limited	Deep moist soils, cool sites
Maple Mountain (*Acer spicatum*, Lamb.)	Not too Abundant	Moist soils of mountain areas
Chestnut, American (*Castanea dentata* (Marsh) Bokh.)	Was Abundant but is now extinct	Acid soils of shale hills and stony mountain areas
Poplar, tulip (*Liriodendron tulipifera*, L.)	Limited	Deep moist soils of the low valleys
Elm, American (*Ulmus Americana*, L.)	Limited	Deep moist soils of the low valley areas
Locust, black or common (*Robinia Pseudo-acacia*, L.)	Limited	Limestone valleys and shale hills

* Taken from "The Common Trees and Shrubs of Pennsylvania", by George S Perry, Bulletin 33 Published by Commonwealth of Pennsylvania, Department of Forests and Waters, Harrisburg, 1932.

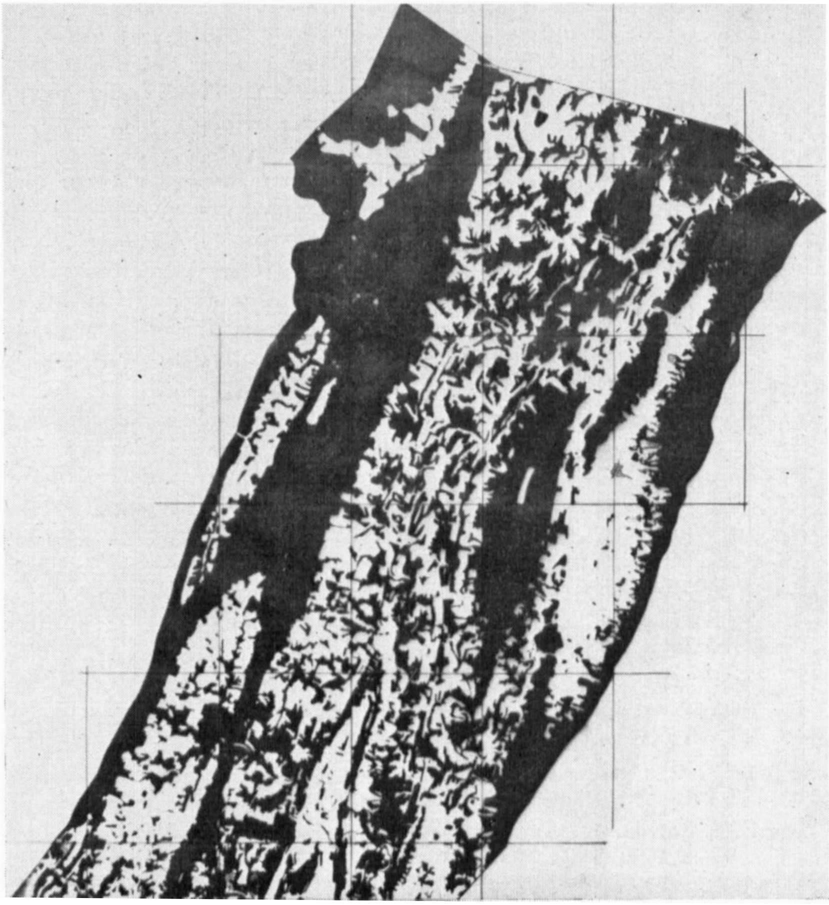

Fig. 26.—Forest cover map of Fulton county. Forests are shown in black and cleared land in white. From map data supplied by the U.S.G.S. Topographic and air photographs supplied by the Pennsylvania State Planning Board, Harrisburg.

Forest resources.—Practically all of the forests in this county have been repeatedly cut through or logged out until there remains but few if any mature stands of timber. At the date of this survey, most of the timber was in what might be called "early maturity" stage of growth. That is, most of the trees had attained normal canopy height but they were not old enough or large enough to be converted into desirable saw logs or quality lumber. Most of the forest will require from 30 to 50 additional years of growth before they will reach maximum lumber value. At the time of this survey, cutting was limited to random selection of the larger trees that could be used for lumber, pulp wood, or

railroad ties. Most of the saw mills were of the small portable type that could be moved easily from one location to another.

Very little actual research data gives growth rates and production capacities for growing forests on these soils but generalized estimates indicate that the yielding capacity for mature forests (age 60 to 80 years) on the Laidig and Hayter soils will range between 200 and 400 board feet per acre per year for oak, and between 300 and 600 board feet per acre per year for white pine. It is generally believed that the growth rates on stony Dekalb or Gilpin soils are about half of those obtained on the deeper and more fertile Hayter or Laidig soils. Growth rates for forests on flood plain soils, where moisture is always abundant, are much higher than those for forests on uplands or mountain areas.

On the basis of depth, fertility, and moisture content, the soils of the upland forest areas may be grouped as follows:

Group I The best. It includes the Hagerstown, Frankstown, Hayter, Laidig, Lehew, and Clymer series.

Group II Intermediate—This group includes the Calvin, Dekalb, Grafton, and Rayne soils.

Group III The poorest and most droughty soils are the Gilpin, Amberson, the steeper areas of Calvin, and the Leetonia soils.

From the very earliest history of Fulton county, the forests have contributed greatly to the economic welfare of the people of the area. The same statement may be projected into the future; the best future use for more than half of the land in this county is for the growth of forests. In addition, there are large areas of idle land that should be replanted to trees.

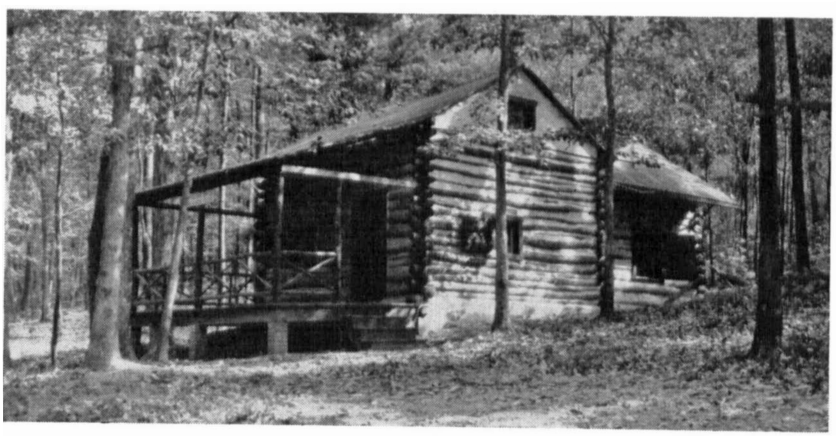

Fig. 27.—This hunting cabin is typical of many that are located in the forested areas of Fulton county.

Productivity Ratings for Soils and Crops, Fulton Count

Soil Group	Soil Series	† YIELDS PER ACRE Corn	Wheat	Oats	Winter Barley	Buckwheat	Clover and Timothy	Clover	Alfalfa	oo Im Pas Ani
		bu.	bu.	bu.	bu.	bu.	tons	tons	tons	a
	Huntington	50-60-90	* * *	* * *	* * *	20-25-35	2 -2.5-2.5	1.5-2.0-2.5	2-2.5-3	
I-A	Lindside	30-50-85	* * *	* * *	* * *	20-25-35	2 -2.5-2.5	1.2-2.0-2.5	* * *	
	Dunning	* -30-60	* * *	* * *	* * *	15-20-25	1 -1.2-2	1 -1.2-1.5	-----	1
	Elk	40-60-90	15-25-40	20-35-50	15-30-50	15-25-30	1.2-2 -2.5	1.2-2 -2.5	2-2.5-3	1
	Moshannon	35-60-70	* * *	* * *	* * *	15-20-25	1 -1.5-2	1 -1.5-2	* * *	1
I-B	Senecaville	* -50-60	-----	* * *	-----	* * *	1 -1.5-2	1 -1.5-2	-----	1
	Cassville	30-60-70	10-20-35	15-30-40	12-25-35	15-25-30	1.5-2 -2.5	1 -1.5-2	* - 2-2.5	1
	Pope	40-50-70	* * *	* * *	* * *	20-25-30	1 -1.5-2	1 -1.5-2	* * *	1
	Philo	30-40-60	* * *	* * *	-----	15-20-25	1 -1.5-2	1 -1.5-2	-----	1
I-C	Atkins	* * *	-----	-----	-----	-----	* * *	-----	-----	2
	Holston	40-55-80	10-20-35	15-30-40	15-30-50	20-25-30	1 -1.5-2	1 -1.2-2	* *-2.5	1
	Monongahela	* -40-65	* -15-30	* * *	* * *	15-20-25	1 -1.5-2	.5-1 -2	-----	1.
	Tyler	* * *	* * *	* * *	-----	10-15-20	.5 -1 -1.2	* * *	-----	2

† Where crop yields are reported in bushels or tons per acre, for example 20-40-50 bushels or .5-1-1.5 that are often obtained on low fertility or eroded areas. The second or middle figure indicates the approximat practices that were in general use when this survey was made, and the third or last figure indicates average the fertility of the soil is kept at a very high level. Such yields are rarely obtained unless the soil has and manure.

oo The term "acres per animal unit" refers to the number of acres of improved pasture land necessary is needed for a mature horse or cow throughout the grazing season from May 1 to November 1. Ratings proved pastures in Fulton county are primarily areas of weeds, brambles, or poverty grass which have but

* This symbol indicates the productivity of the soil is limited by factors that do not permit an econon The limiting factors may be stony soils, low fertility, poor water or air drainage, flood water overflows, er subject to change or improvement.

--- The dash marks indicate the soil was not used for the production of that crop, fruit, or pasture.

(Table continued on next page)

Productivity Ratings for Soils and Crops, Fulton County, Pa.

Soil Group	Soil Series	Corn	Wheat	Oats	Winter Barley	Buckwheat	Clover and Timothy	Clover	Alfalfa	oo Im Pa Ani
		† YIELDS PER ACRE								
		bu.	bu.	bu.	bu.	bu.	tons	tons	tons	a
	Hagerstown	35-50-75	12-30-40	20-35-60	15-30-45	15-20-30	1-1.5-2	1 -1.5-2	*-1.5-2.5	1
II-A	Frankstown	30-50-70	10-25-35	15-30-50	10-25-40	15-20-30	1-1.5-2	1 -1.5-2	*-1.5-2.5	1
	Elliber	* * *	* * *	* * *	* * *	* * *	-----	-----	-----	*
II-B	Murrill	40-55-90	10-25-40	15-35-60	15-30-50	15-20-30	1-1.5-2	1 -1.5-2	*-1.5-2.5	1
	Buchanan	* -35-55	* -20-30	* * *	* * *	15-20-30	1-1.5-2	.5-1 -1.5	-----	1
III	Mattawana	20-40-50	10-15-20	10-20-35	10-20-35	10-15-20	.5-1.0-1.5	.5-1 -1.5	*-1.5-2	2
	Calvin	20-40-50	8-15-25	10-20-35	10-20-35	10-15-20	.5-1.0-1.5	.5-1 -1.5	*-1.5-2	2
	Rayne(Lashley)	20-40-50	8-15-20	10-20-30	10-20-30	10-12-15	.5-1.0-1.5	*-.75 -1	* *-1.5	2
IV	Gilpin(Ashby)	10-25-35	6-12-15	5-15-25	5-20-25	5-10-15	.5-.75-1	*-.75 -1	* *-1.0	2
	Amberson	10-25-35	6-12-15	5-15-25	5-20-25	5-10-15	.5-.75-1	*-.75 -1	* *-1.0	2
	Laidig	-----	-----	-----	-----	-----	-----	-----	-----	-
	Grafton	-----	* * *	* * *	-----	* * *	-----	-----	-----	*
	Hayter	-----	-----	-----	-----	-----	-----	-----	-----	-
IV	Lehew	-----	-----	-----	-----	-----	-----	-----	-----	-
	Clymer	10-30-40	8-15-20	5-20-35	5-20-30	5-10-15	.5-.75-1	* -.75-1	* *-1.5	1.
	Dekalb	-----	-----	-----	-----	-----	-----	-----	-----	-
	Leetonia	-----	-----	-----	-----	-----	-----	-----	-----	-

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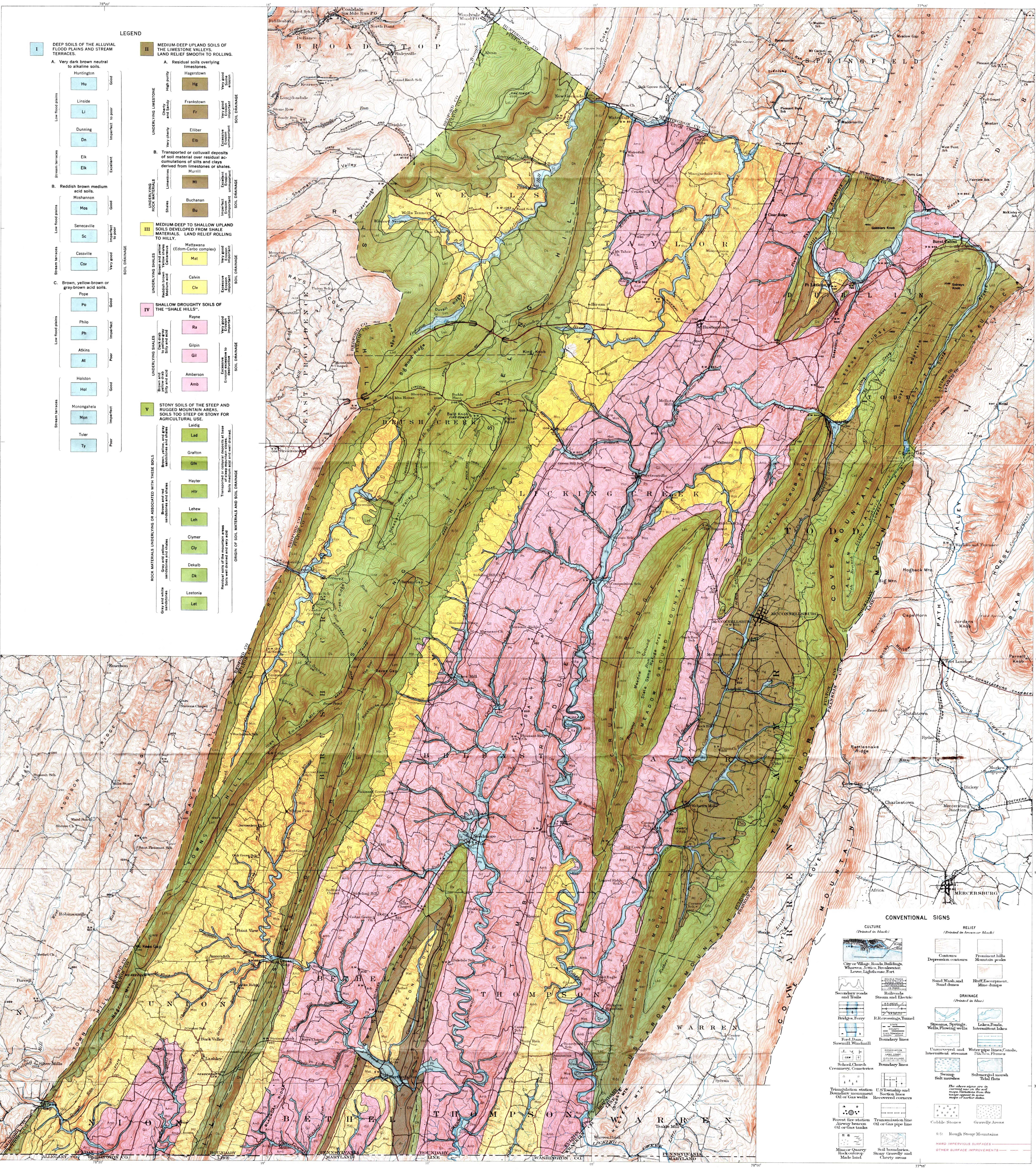
HOWARD W. HIGBEE, STATE SOIL SURVEY LEADER

SOIL MAP
FULTON COUNTY
PENNSYLVANIA

U. S. DEPARTMENT OF AGRICULTURE
BUREAU OF PLANT INDUSTRY
E. C. AUCHTER, CHIEF
DIVISION OF SOIL SURVEY, CHARLES E. KELLOGG, CHIEF
MAP DRAFTING, J. W. M KERICHER, IN CHARGE



In agreement with correlations as established by Division of Soil Survey, U. S. Department of Agriculture, Bureau of Plant Industry, and in cooperation with W. J. Latimer, Inspector for the region.

BASE MAP FROM
U. S. GEOLOGICAL SURVEY SHEETS
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WASHINGTON, D. C.

Scale $\frac{1}{62500}$

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PUBLISHED IN 1943

Soil classification and survey by
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